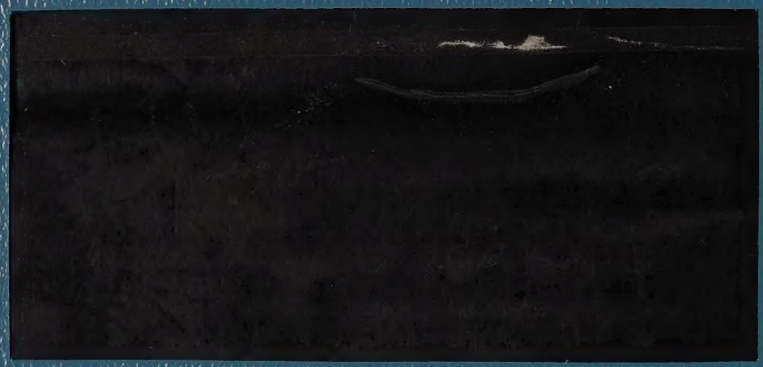
ITHACO



INSTRUCTION AND MAINTENANCE MANUAL

ITHACO S SERIES CASES

ITHACO P10 SERIES POWER SUPPLIES

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MARCH, 1982

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TABLE OF CONTENTS

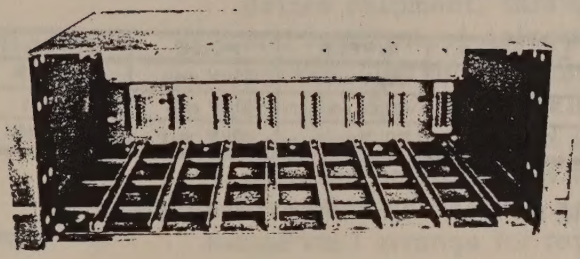
SECTION		DESCRIPTION	PAGE
1		SPECIFICATIONS	
2		INSTALLATION	
	2.1	Inspection	2 - 1
	2.1.1	General	2 - 1
	2.1.2	Visual Inspection	2 - 1
	2.1.3	Electrical Inspection	2 - 1
	2.2	Power Source Requirements	2 - 1
	2.3	Standby Battery Operation	2 - 2
	2.4	Independent Power Supply Operation	2 - 2
	2.5	System Grounds	2 - 3
	2.6	Inter-Channel Wiring	2 - 3
3		OPERATION	
4		THEORY OF OPERATION	
	4.1	Transformer	4 - 1
	4.2	Positive 15V Regulator	4 - 1
	4.3	Negative 15V Regulator	4 - 2
	4.4	±28 Volt Regulator	4 - 2
	4.5	-55 Volt Regulator	4 - 2
	4.6	Cal Oscillator	4 - 3
5		MAINTENANCE AND CALIBRATION	
	5.1	General	5 - 1
	5.2	Calibration	5 - 1
	5.2.1	Cal Oscillator Amplitude	5 - 1
	5.2.2	-15V Amplitude	5 - 1
	5.2.3	+15V Amplitude	5 - 1
6		DRAWINGS	
	6.1	S11 Series Case - Assembly	
	6.2	S21 Series Case - Assembly	
	6.3	S11-S21 Series Case - Wiring Diagram	
	6.4	S Series Case - Option 01 - Modification Instruction	
	6.5	S Series Case - Option 01 - Assembly	
	6.6	S Series Case - Option 02 - Modification Instruction	
	6.7	S Series Case - Option 19 - Modification Instruction	
	6.8	S Series Case - Option 19 - Wiring Diagram	
	6.9	S Series Case - Option 23 - Modification Instruction	
	6.10	S Series Case - Option 23 - Wiring Diagram	
	6.11	S Series Case - Option 27 - Assembly Instructions	
	6.12	S Series Case - Option 27 - Wiring Diagram	

TABLE OF CONTENTS (Continued)

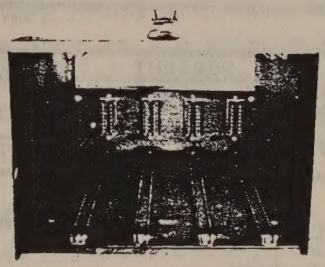
SECTION		DESCRIPTION	PAGE
6		DRAWINGS (Continued)	
	6.13	P Series Power Supply - Assembly	
	6.14	P Series Power Supply - Primary Power Wiring	
	6.15	P Series Power Supply - -15V/+15V Regulator - Assembly	
	6.16	P Series Power Supply - +15 Volt Regulator - Schematic	
	6.17	P Series Power Supply - -15V Regulator - Schematic	
	6.18	P Series Power Supply - ±28V Regulator - Assembly	
	6.19	P Series Power Supply - -28V/+28V Regulator - Schematic	
	6.20	P Series Power Supply - -55V Regulator - Assembly	
	6.21	P Series Power Supply - -55V Regulator - Schematic	
	6.22	P Series Power Supply - Cal Oscillator Assembly	
	6.23	P13, P16, P17 Series Power Supplies - Cal System - Schematic	
7		REPLACEABLE PARTS	
	7.1	Introduction	7 - 1
	7.2	Reference Designations and Abbreviations	7 - 1
	7.3	Code List of Manufacturers	7 - 1
		Replaceable Parts - Model P11	7 - 3
		Replaceable Parts - Model P12	7 - 6
		Replaceable Parts - Model P13	7 - 10
		Replaceable Parts - Model P14	7 - 16
		Replaceable Parts - Model P16	7 - 20
		Replaceable Parts - Model P17	7 - 26

POWER SUPPLIES, CASES AND ACCESSORIES

P17 Power Supply



S11 Rackmount



S21 Portable Case

Z1 Plug-In Chassis

ITHACO's P Series Power Supplies and S Series cases provide maximum flexibility in the creation of single and multi-channel systems. The modular approach permits the user to build complex custom systems for current needs at minimum cost. Then at a later date the system can be modified to meet new requirements by substituting other plug-in modules.

The S Series Cases are used to house any ITHACO model which is packaged in a 6.75" high, 2" wide, and 10.5" deep plug-in chassis. The S10 Series accepts up to 7 plug-in channels for rackmount applications, while the S20 Series accepts up to 3 channels in a portable configuration. Any P Series Power Supply can be plugged into the extreme left slot of the case to provide dc power and, for certain supplies, a calibration signal to all modules in the case.

P Series Power Supplies are dual-voltage, regulated power supplies which operate over a wide range of input voltages and frequencies, and feature electrostatic shielding, magnetic shielding, low noise, and low ripple. Additional features available include a 1 kHz calibration oscillator with power driver, and one of the following plug-in regulators:

+28 VDC, −28 VDC, or −55 VDC

Provisions have been made in all models for standby battery operation from external batteries.

The following table shows compatible power supplies and cases for various products:

MODELS	7-CHANNEL RACKMOUNTS	3-CHANNEL PORTABLE CASES	P SERIES POWER SUPPLIES
451, 452, 453, 454 4111, 4112, 4113	S11	S21	P11[1] through P17
455, 456	S11	S21	P14
461[3]	S11	S21	P17[1,2], P13[2], P16[2]
471[3]	S11 (Option 01 required)	S21 (Option 01 required)	P16[2]

[1] Recommended model [2] Includes calibration oscillator [3] Includes calibration circuitry

POWER SUPPLY SPECIFICATIONS

INPUT FREQUENCY	47 Hz – 440 Hz		
INPUT VOLTAGE	Taps on the primary of the power transformer are wired:		
	STANDARD	117 Volts Nominal	(105V – 130V)
	OPTION 01	100 Volts Nominal	(90V – 110V)
	OPTION 02	200 Volts Nominal	(180V – 220V)
	OPTION 03	235 Volts Nominal	(210V – 260V)

POWER SUPPLY SPECIFICATIONS (CONTINUED)

OUTPUTS

FUNCTION	P11	P12	P13	P14	P15	P16	P17
±15V	YES	YES	YES	YES	YES	YES	YES
PREAMPLIFIER POWER	NO	+28V	+28V	NO	−28V	−28V	NO
−55V	NO	NO	NO	YES	NO	NO	NO
CAL OSCILLATOR	NO	NO	YES	NO	NO	YES	YES
RELAY POWER	NO	NO	+24 to +28V	NO	NO	+24 to +28V	+24 to +28V

	CURRENT	LINE REG.	LOAD REG.	RIPPLE	NOISE	STABILITY	ACCURACY
±15V	1000 MA	0.05%	0.01%	20μV rms	25μV rms	±0.1%	ADJ.
±28V	200 MA	0.05%	0.1%	20μV rms	40μV rms	±1%	±3%
−55V	100 MA	0.05%	0.1%	20μV rms	40μV rms	±0.1%	±3%

CAL OSCILLATOR/BUFFER (Models P13, P16, P17 only)

FREQUENCY

Accuracy	1 KHz ±5%
Stability	1% Time and Temperature

AMPLITUDE

Level	0.707 to 1V rms, internally adjustable
Stability	±0.5% Time and Temperature
Distortion	0.5% maximum

OUTPUT REGULATION

(1V rms Out)	0.25% with 50Ω Load
	1% with 10Ω Load
	2% with 7Ω Load

CONTROLS

Cal Switch	Front Panel Toggle Cal/Operate
Cal Monitor	Isolated Front Panel BNC

CASE SPECIFICATIONS

	MODEL S11 RACKMOUNT	MODEL S21 PORTABLE CASE
SIZE	7" high, 19" wide, 14" deep	7" high, 9.5" wide, 14" deep
CAPACITY	7 channels plus power supply	3 channels plus power supply
PAINT	Black	Black

ACCESSORIES

X1	EXTENDER CABLE	A blank plug-in chassis with extension cable
Y1	BLANK PANEL	
Z1	BLANK PLUG-IN CHASSIS	Permits integration of user's circuitry

Printed in USA

2.0 INSTALLATION

2.1 INSPECTION

2.1.1 GENERAL

Before shipment, this unit was found to be free of electrical and mechanical defects. As soon as the instrument is unpacked, inspect for any damage that may have occurred in transit. Save all packing materials until the inspection is complete. If damaged in any way, a claim should be filed with the carrier and a copy forwarded to ITHACO. ITHACO will then advise you as to the disposition of the equipment and will arrange for repair or replacement without waiting for a claim against the carrier.

2.1.2 VISUAL INSPECTION

A visual check should be made to confirm that there are no broken knobs or connectors, and that the case and panel surfaces are free of dents and scratches.

2.1.3 ELECTRICAL INSPECTION

The instrument should be checked against its electrical specifications.

2.2 POWER SOURCE REQUIREMENTS

P Series Power Supplies will operate within specifications from power frequencies for 47 Hz to 440 Hz and a wide range of input voltages depending on the connections of the power transformer. Four input voltage options are available from the factory.

Standard Input Voltage	117V nominal (105V to 130V)
Option 01	100V nominal (90V to 110V)
Option 02	200V nominal (180V to 220V)
Option 03	234V nominal (210V to 260V)

NOTE: Connections required for each of the input voltage ranges is described on the Power Supply Primary Power Wiring Diagram.

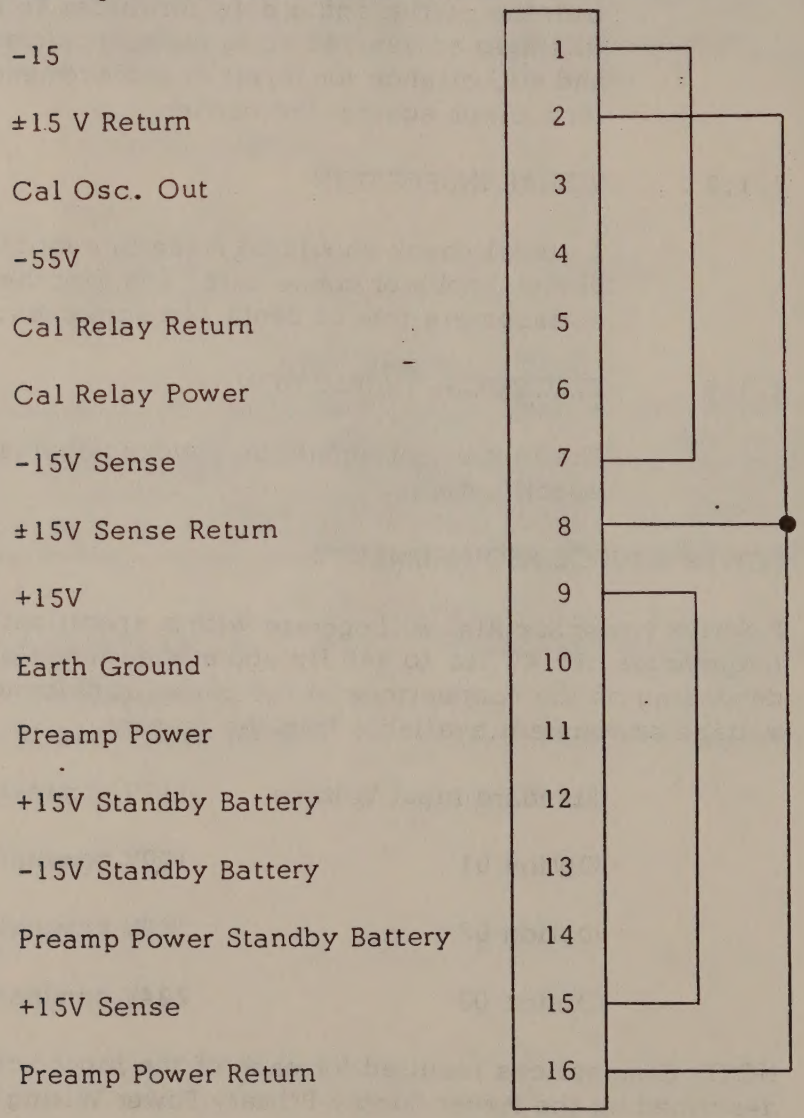
2.3 STANDBY BATTERY OPERATION

The service connector on the rear of the S Series cases has connections for standby battery operation. Figure 2.3 shows the connections for standby battery operation for various P Series Power Supplies. External fuses should be provided to protect the batteries during an accidental short.

2.4 INDEPENDENT POWER SUPPLY OPERATION

For operation of the P Series Power Supplies independent of the S Series mounting cases, the connections shown below must be made:

Mating: AMPHENOL BLUE RIBBON #26-4200-16S



2.5 SYSTEM GROUNDS

A system ground terminal is provided on the rear of each S Series case which permits the power ground to be jumpered to system ground by means of a terminal clip. In those systems which operate with other portions of the system connected to power ground, it may be advantageous to operate without this jumper. The P Series Power Supply chassis and the S Series Cases are always connected to power ground. The plug-in instrument chassis is isolated from the case and connected to circuit ground.

2.6 INTER-CHANNEL WIRING

The S Series Cases provide interchannel wiring of power and calibration, but in most cases input, output and control connections are made on the rear of the plug-in chassis. Refer to wiring diagram for the particular S Series case.

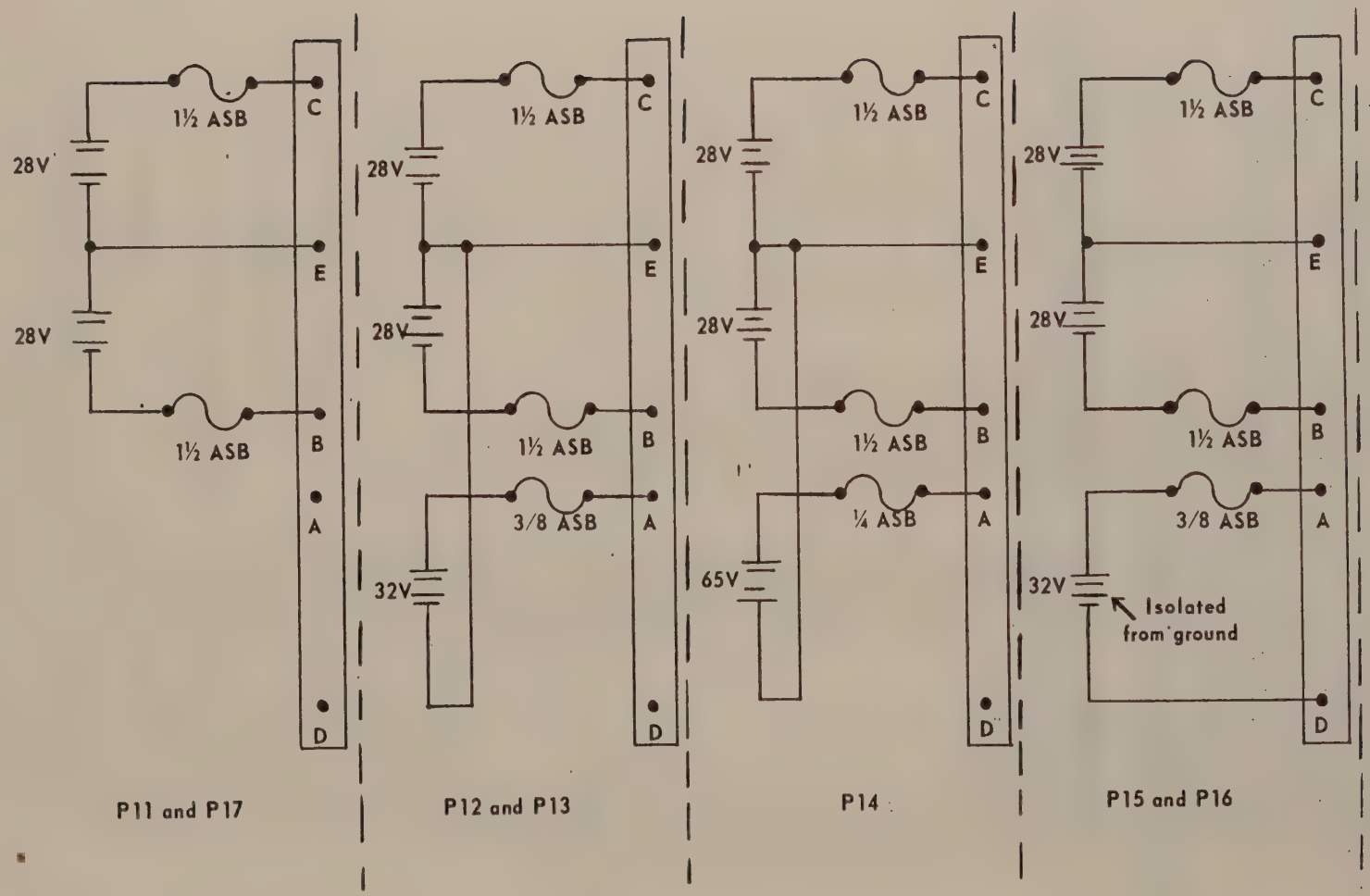
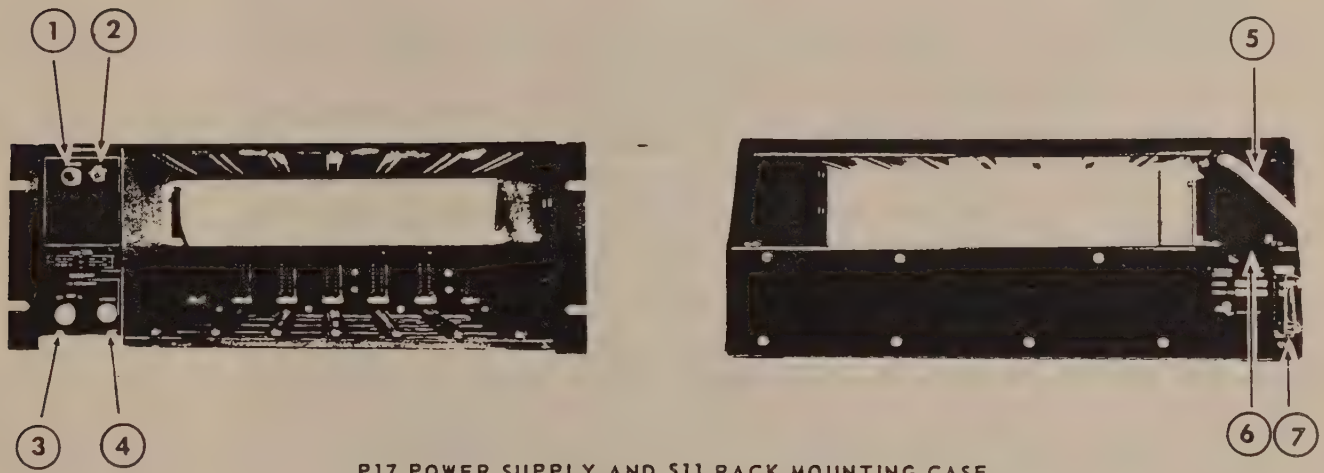


FIGURE 2.3 STANDBY BATTERY CONNECTIONS FOR P SERIES POWER SUPPLIES

OPERATION

P17 POWER SUPPLY AND S21 PORTABLE CASE



P17 POWER SUPPLY AND S11 RACK MOUNTING CASE

(1)	POWER ON/OFF SWITCH WITH POWER LAMP (push ON/push OFF)	
(2)	POWER FUSE	(3AG, 1½ A for input voltage 90 V – 130 V) (3AG, ¾ A for input volage 180 V – 260 V)
(3)	CALIBRATION SWITCH	Turns on Calibration Oscillator and energizes Cal Relays
(4)	CAL MONITOR	Monitor output of Cal Driver
(5)	POWER CORD	3–wire power cord for 115 VAC, 60 Hz
(6)	GROUND TERMINAL	The power ground and system ground are brought out on this terminal. A permanently attached clip is used to jumper the two grounds together
(7)	SERVICE CONNECTOR	Galvo Output connections and external Standby Battery connections

4.0 THEORY OF OPERATION

4.1 TRANSFORMER

The power transformer, T1, has a multi-tapped primary which permits, by the proper choice of tap connection, operation over a wide range of input voltages. Normally the transformer is connected for 105-130 V rms. See Primary Power Wiring Diagram for connections.

4.2 POSITIVE 15V REGULATOR

Referring to the +15 volt regulator schematic, note the positive and negative regulator use the same secondary of T1 for input power. This secondary is center-tapped. The output of the transformer is full wave rectified by CR1 and CR2. C1 filters the DC from the rectifier. The regulator is a series regulator with foldback current limiting and remote sensing. The sense leads are connected to the output leads at the mating rack connector. If the supply is used outside of a rackmount, this connection must be made, terminal 15 to 9 and 2 to 8. CR7 and CR3 connect the sense leads to the output leads in the supply to prevent damage if the external connection is not made. Resistors R9, R12 and potentiometer R11 are used to feed back a portion of the output to AR1. AR1 compares the feedback voltage with a reference voltage, generated by temperature compensated zener, CR6. C4 increases the feedback for AC signals, decreasing the ripple and improving the transient response. C5 shunts the zener reference, decreasing the effect of noise voltage generated by the zener. AR1 amplifies the error voltage and applies it to the source of field effect transistor Q3. Q3 is used to couple the output of AR1 to the series pass Darlington connected transistor, Q2, (rear panel mounted). If the output decreases for any reason, the voltage on the wiper of R11 will be below the reference voltage. The output of AR1 will decrease. This results in a smaller gate-to-source voltage for Q3 resulting in an increase in drain current. The increase in drain current flows from the base of Q2, the series pass transistor, causing an increase in collector output current, thereby increasing the output voltage. C6 and C7 connected across the output, increase the transient capabilities of the supply. CR5 clamps the output of the supply in case of an external malfunction tending to pull it negative.

CR4 provides protection for Q2 from reverse bias if C1 is shorted. Q1, Q2, R2, R3, R4 and rear panel mounted resistor R2 are used to provide foldback current limiting. R2 and R3 form a voltage divider to the base of Q2, biasing Q2 off. The output current flows thru current sensing resistor R2 (rear panel mounted). If the output of the supply is overloaded or short circuited, the voltage across R2 increases to a point where Q2 is forward biased causing collector current to flow in Q2. The collector current for Q2 flows from the base of Q1 turning it on. Q1 then supplies current to the drain of Q3 reducing the flow of base current from Q1,

holding the collector current to a safe limit. The output voltage in the case of a severe overload will drop, reducing the voltage across the current sense resistor, R2, required to keep Q2 on. The output current then reduces or "foldsback".

4.3 NEGATIVE 15V REGULATOR

The operation of the Negative 15V regulator is analoguous to the +15 V Regulator. Refer to Elementary Diagram for -15V Regulator.

4.4 ±28 VOLT REGULATOR

Refer to Elementary Diagram for -28 Volt Regulator or +28 Volt Regulator. The operation of the ±28 Volt Regulator is similar to the operation of the +15 V Regulator except the input rectifier is a full wave bridge and remote sensing is not provided. This regulator is self-contained on one plug-in card. Jumper connections are provided (see note 2 on drawing), to permit operation as either a positive or negative 28 V supply.

4.5 -55 VOLT REGULATOR

Refer to Elementary Diagram for -55 Volt Regulator. The -55 Volt Regulator is self-contained on one plug-in card. CR1, CR2, C1 and C2 form a voltage doubler rectifier and filter. The regulator circuit consists of AR1, Q2 and Q1. Q3 and Q4 provide current limiting. The regulator can be thought of as one inverting amplifier with gain of 3.73. The input is the +15 sense voltage applied to R13. The output is fed back by R11. The junction of R11 and R12 is a virtual ground. AR1 provides gain. An error voltage at its input is amplified and applied to the base of Q2 which provides current amplification for the series pass transistor Q1. Q1 is protected against reverse bias, if the input filter is shorted, by CR3. CR7 clamps the output to ground for output malfunctions tending to pull the output positive. C5 improves the output transient response. C4 increases the feedback for AC reducing output ripple and noise.

R8 provides current sensing. In case of overloads or short circuits, the voltage developed across it will turn on Q4 and then Q3 which tends to turn off Q2, thereby holding the current thru Q1 to a safe value. If the load demands more current, the output voltage will drop, decreasing the voltage across R7 which increases the effect of the voltage across R8. Less voltage across R8 (less current thru it) will be required to keep Q4 on and the output current will decrease or "foldback".

Both +15VDC and -15VDC are required for proper operation of this regulator. This card plugs into the same spot as the ±28V card, consequently no power supply has both regulators.

4.6 CAL OSCILLATOR

Refer to elementary diagram for Cal System. AR1, R1, R2, C1, C3 form a 2-pole low-pass filter with 90° phase shift and 3 dB attenuation at 1000 Hz. AR2, R3 and C5 form an integrator with phase shift of 270° and gain slightly more than 3 dB at 1000 Hz. The two stages then oscillate at 1000 Hz. CR1 and CR3 provide amplitude stability since they clip the sine wave at ±6.2V. The clipped sine wave is filtered by AR1 and AR2 and is applied as the input to AR3.

AR3 is connected as an inverting amplifier with gain less than unity. The actual gain is adjusted by R17. The output level can be set between 0.707V rms to 1V rms by adjusting R17. AR3 is a power driver and permits 50 ohm loads.

5.0 MAINTENANCE AND CALIBRATION

5.1 GENERAL

Access to the circuitry is obtained by removing the two side panel screws from the right side panel, and sliding the panel towards the rear and the two retaining screws at each end of the left side panel. If either a ±28 V regulator card of -55V regulator card is present, it may be removed by removing the two screws at the bottom of the printed circuit cards and the two screws that go thru the top rail into the heatsink bar at the top of the card. Do not attempt to remove the top two screws (slots filled with epoxy) or any screws in the bottom rail. The Cal Oscillator circuitry is exposed by pushing the cal oscillator card toward the transformer until the four rubber grommets clear the studs and then pull the card to the left.

5.2 CALIBRATION

5.2.1 CAL OSCILLATOR AMPLITUDE

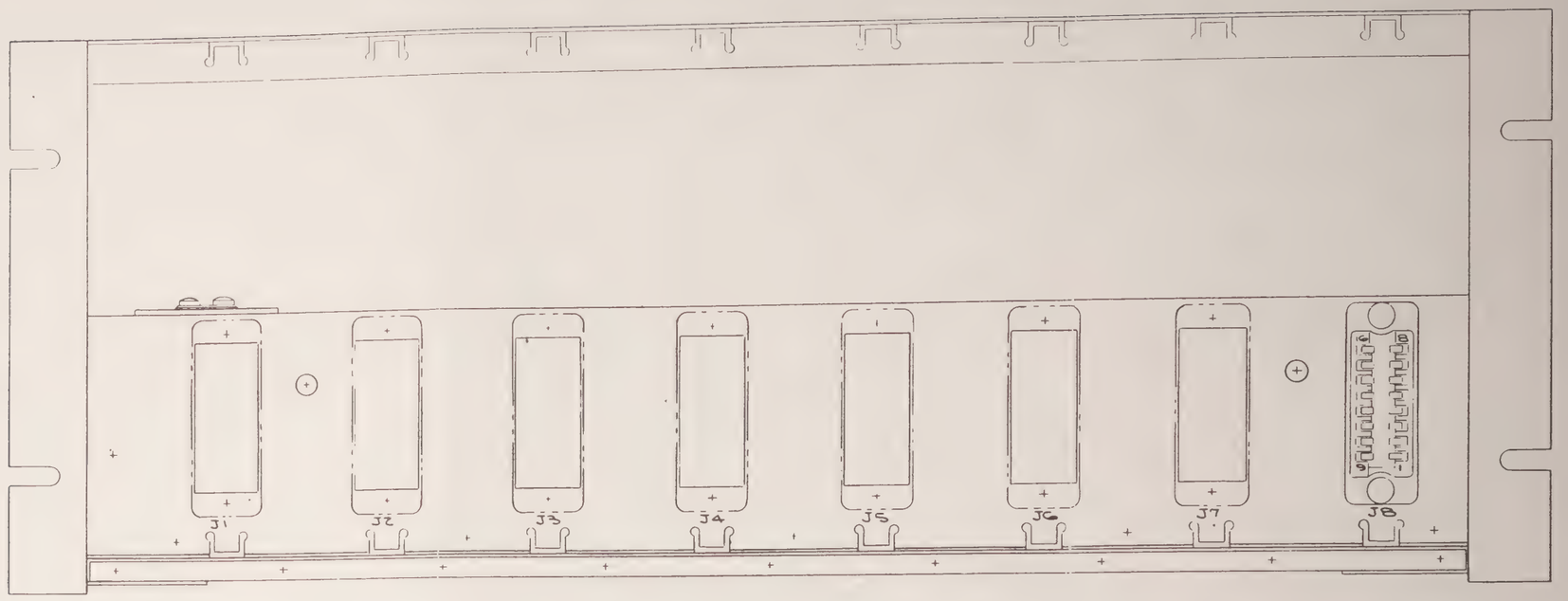
Remove left side panel. With Operate/Calibrate switch in Calibrate, monitor the cal signal. Adjust the amplitude to the required value with R17 (CW increases amplitude).

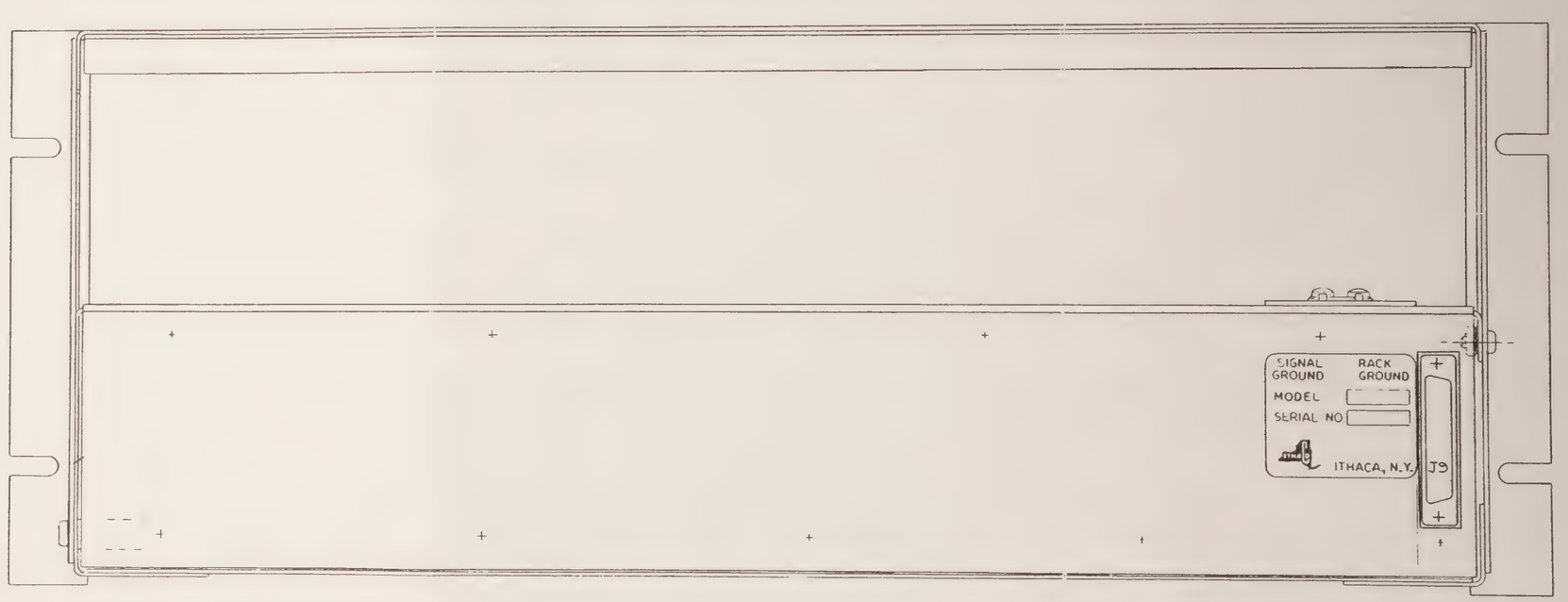
5.2.2 -15 V AMPLITUDE

Remove left side panel. Use a suitable adapter which connects the sense leads to the corresponding output. (See section 2.4). Adjust R23 for - 15V (CW increases amplitude).

5.2.3 +15 V AMPLITUDE

Remove left side panel, and ±28V Regulator card or -55V Regulato card if present. Use a suitable adapter which connects the sense leads to the corresponding output (see Section 2.4). Adjust R11 for +15V (CW increases amplitude).





ITHACO DWG D41106, SH 1, REV A, 3/78

FIGURE 6.1
S11 SERIES CASE
ASSEMBLY

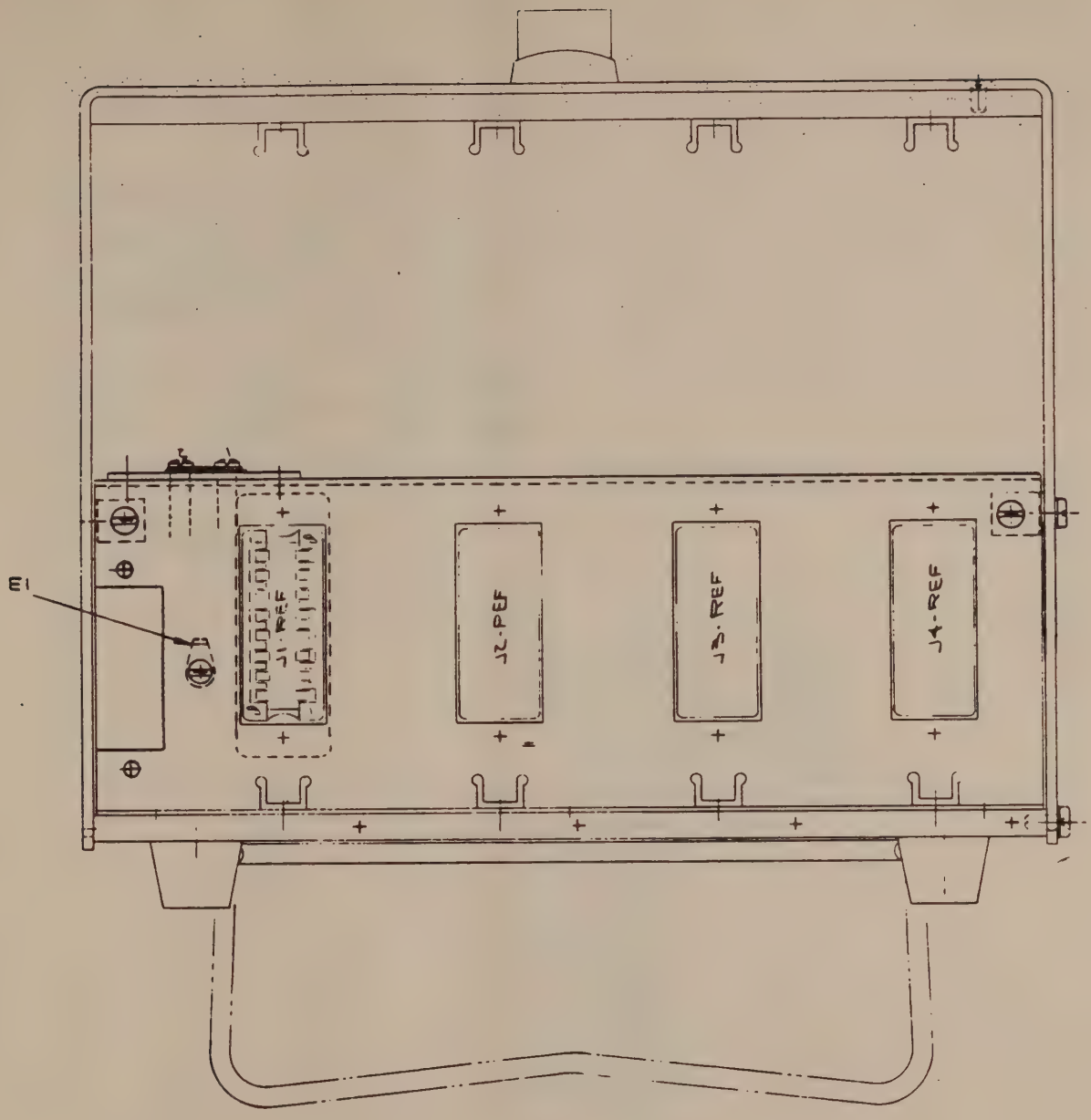
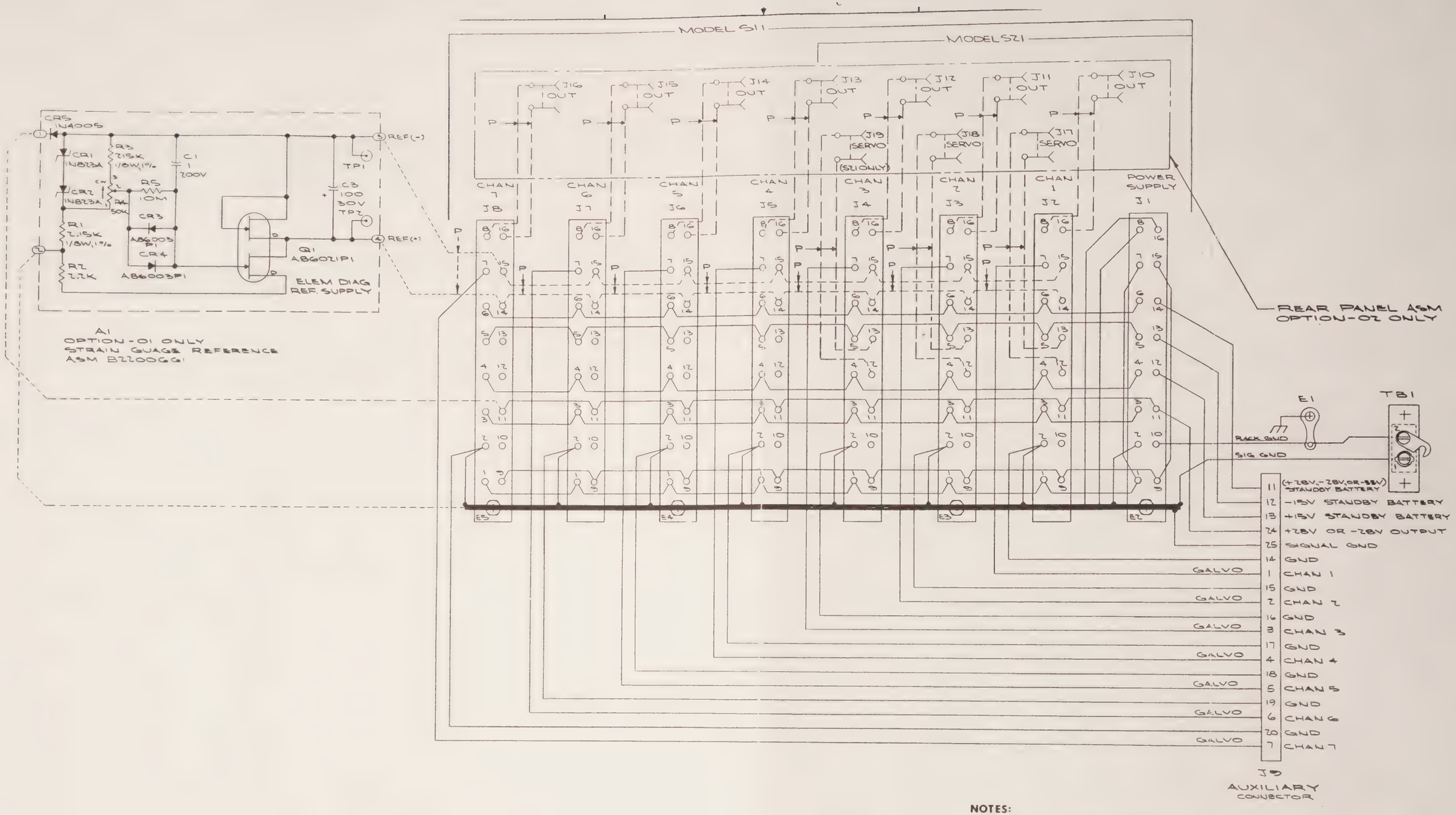


FIGURE 6.2
S21 SERIES CASE
ASSEMBLY

ITHACO DWG C31521, SH 1, REV A, 7/74



8	(4G1 TAPE OUT)	16	(4G1 TAPE GND)
7	GALVO OUT	15	REF(-) OPTION -01 ONLY
6	CAL RLY PWR	14	REF(+) OPTION -01 ONLY
5	CAL RLY RET	13	(4G1 SERVO GND)
4	-55VDC	12	(4G1 SERVO OUT)
3	CAL OSC	11	PREAMP PWR
2	SIGNAL GND	10	
1	-15VDC	9	+15VDC
PIN	FUNCTION	PIN	FUNCTION

J2 THRU J8 PIN ASSIGNMENT

8	+15V SENSE RET	16	+28V,-28V,OR-55V RET
7	-15V SENSE	15	+15V SENSE
6	CAL RLY PWR	14	+28V,-28V OR -55V STANDBY BATT
5	CAL RLY RET	13	-15V STBY BATT
4	-55VDC	12	+15V STBY BATT
3	CAL OSC	11	PREAMP PWR
2	SIGNAL GND	10	POWER GND
1	-15VDC	9	+15VDC
PIN	FUNCTION	PIN	FUNCTION

J1 PIN ASSIGNMENT

NOTES:

1. **UNLESS OTHERWISE SPECIFIED: RESISTOR VALUES ARE IN OHMS. RESISTORS ARE 1/4W, CARBON COMPOSITION, 5% TOL. CAPACITOR VALUES ARE IN MICROFARADS.**
2. J1 THRU J8 ARE AMPHENOL #76-4700-165, J9 IS CANNON DBM-25D

ITHACO DWG D41084, SH 1, REV D, 11/77

FIGURE 6.3
S11 – S21 SERIES CASE WIRING DIAGRAM

MODIFICATION INSTRUCTION
MOUNTING FRAME
OPTION -01

SCOPE: THIS DOCUMENT IS ESTABLISHED AS A SOURCE OF INFORMATION FOR THE PURPOSE OF INCLUDING AN OPTION -01 IN A MODEL S11 RACK MOUNTING FRAME (ASM. DWG. NO. D41106G1) OR A MODEL S21 PORTABLE MOUNTING FRAME (ASM. DWG. NO. C31521G1).

DEFINITION: OPTION 01 CONSTITUTES THE ADDITION OF A REAR PANEL MOUNTED STRAIN GAUGE REFERENCE CARD TO A S11 OR S21 MOUNTING FRAME.

GENERAL: THE FOLLOWING TEXT CONTAINS A LIST OF PARTS TO BE ADDED TO THE UNIT, A LIST OF INSTRUCTIONS, A VIEW SHOWING THE AREA OF CHANGE AND A RUNNING LIST.

REFERENCE DWGS:

D41106G1	ASM RACK MOUNTING FRAME S11
C31521G1	ASM PORTABLE MOUNTING FRAME S21
D41084	ELEM. DIAG. MOUNTING FRAME
B22006G1	ASM, REFERENCE SUPPLY

ITHACO DWG A11230, SH 1, 5/72

FIGURE 6.4 S SERIES CASE – OPTION 01 – MODIFICATION INSTRUCTIONS – SH 1

MODIFICATION INSTRUCTION
MOUNTING FRAME
OPTION -01

LIST OF ADDITIONS TO THE
FINAL MODEL ASSEMBLY

ITEM	IDENTIFICATION NO.	DESCRIPTION	QTY
A1	B22006G1	ASM, REF. SUPPLY CARD	1
101	812811408	SCR. PAN HD. SLOTTED #4-40x1/4"LG.	8
102	812841114	LOCKWASHER INT. TH. #4	8
103	A10447P1	LABEL (SEE INSTRUCTION NO. 6)	1
104	812850028	SPACER, HEX #4-40 x 1/4" AF x 3/4" LG	4

FIGURE 6.4 S SERIES CASE – OPTION 01 – MODIFICATION INSTRUCTIONS – SH 2

MODIFICATION INSTRUCTION
MOUNTING FRAME
OPTION 01

INSTRUCTIONS

1. PULL FROM STOCK A MODEL S11 RACK MOUNTING FRAME (ASM DWG. NO. D41106G1) OR A MODEL S21 PORTABLE MOUNTING FRAME (ASM DWG. NO. C31521G1).

2. REMOVE REAR PANEL.

3. ASSEMBLE 4 SPACERS, ITEM NO. 104, TO CONNECTOR PANEL USING 4 EACH OF HARDWARE ITEMS NO. 101 AND 102 AS SHOWN ON SHEET 4 OF THIS INSTRUCTION.

4. ATTACH A1 CARD (ASM DWG. NO. B22006G1) TO 4 SPACERS PROVIDED USING HARDWARE ITEMS NO. 101 AND 102 AS SHOWN ON 4 OF THIS INSTRUCTION.

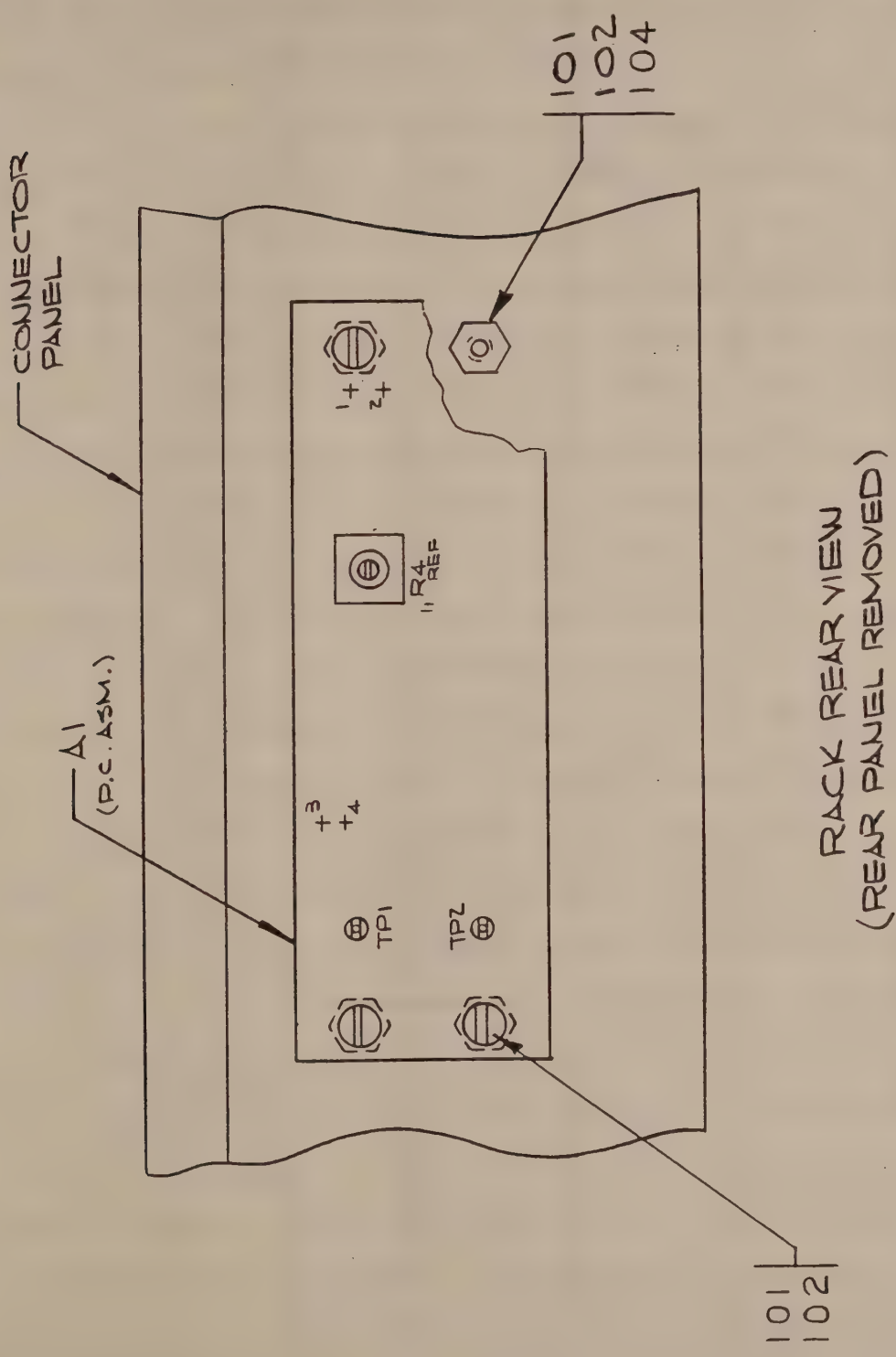
5. ADD FOUR WIRES PER ATTACHED RUNNING LIST (FOR ELEM DIAG, SEE D41084).

6. INSPECT AND TEST FOR THIS ADDITION AND REPLACE REAR PANEL.

7. REPLACE REAR LABEL WITH A NEW LABEL DESIGNATING UNIT AS MODEL S11-01 OR S21-01.

ITHACO DWG A11230, SH 3, REV C, 12/77

FIGURE 6.4 S SERIES CASE – OPTION 01 – MODIFICATION INSTRUCTIONS – SH 3



ITHACO DWG A11230, SH 4, REV C, 12/77

FIGURE 6.4 S SERIES CASE – OPTION 01 – MODIFICATION INSTRUCTION – SH 4

WIRE NO	AWG	COLOR BODY	1ST TRACER	CABLE ROUTING	FROM	TO	FUNC	LGTH (INCHES)
		FOR MODEL S11-01 WIRING SEE BELOW						
1	24	WHT			A1-1	J8-11	INPUT	
2		BLK			A1-2	J8- GND BUSS	GND	
3A		WHT	VIO		A1-3	J8-15	-REF	3 1/4
3B		WHT	RED		A1-4	J8-14	+REF	
4A			RED		J2-14	J3-14	REF +	
4B			VIO		J2-15	J3-15	REF -	
5A			RED		J3-14	J4-14	REF +	
5B			VIO		J3-15	J4-15	REF -	
6A			RED		J4-14	J5-14	REF +	
6B			VIO		J4-15	J5-15	REF -	
7A			RED		J5-14	J6-14	REF +	
7B			VIO		J5-15	J6-15	REF -	
8A			RED		J6-14	J7-14	REF +	
8B			VIO		J6-15	J7-15	REF -	
9A			RED		J7-14	J8-14	REF +	
9B	24	WHT	VIO		J7-15	J8-15	REF -	3 1/4
	NOTE:	A & B	INDICATES TWISTED PAIR					

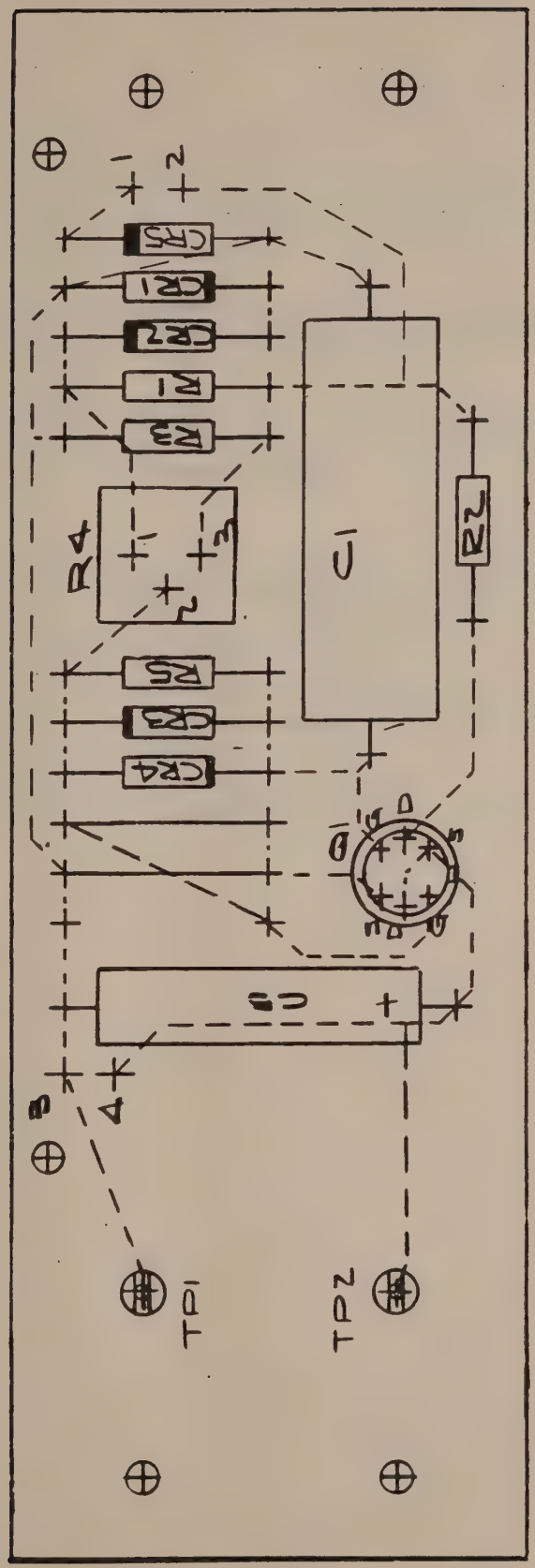
ITHACO DWG A11230, SH 5, REV A, 2/76

FIGURE 6.4 S SERIES CASE – OPTION 01 – MODIFICATION INSTRUCTION – SH 5

WIRE NO	AWG	COLOR BODY	1ST TRACER	CABLE ROUTING	FROM	TO	FUNC	LGTH (INCHES)
	FOR MODEL S21-01 WIRING SEE BELOW							
1	24	WHT			A1-1	J4-11	INPUT	7 1/2
2		BLK			A1-2	J4- GND BUSS	GND	7 1/2
3A		WHT	VIO		A1-3	J4-15	-REF	3 1/2
3B		WHT	RED		A1-4	J4-14	+REF	3 1/2
4A			RED		J2-14	J3-14	REF +	3
4B			VIO		J2-15	J3-15	REF -	3
5A			RED		J3-14'	J4-14	REF +	3
5B	24	WHT	VIO		J3-15	J4-15	REF -	3
	NOTE: A & B INDICATES TWISTED PAIR							

ITHACO DWG A11230, SH 6, REV D, 12/79

FIGURE 6.4 S SERIES CASE – OPTION 01 – MODIFICATION INSTRUCTIONS – SH 6



ITHACO DWG B22006, SH 1, REV A, 11 '77

FIGURE 6.5 S SERIES CASE – OPTION 01 – ASSEMBLY

ASSEMBLY INSTRUCTIONS
MOUNTING FRAME OPTION-02

SCOPE: THIS DOCUMENT IS ESTABLISHED AS A SOURCE OF INFORMATION FOR THE PURPOSE OF INCLUDING AN OPTION IN A MODEL S11 RACK MOUNTING FRAME (ASM DWG. NO. D41106G1) OR A MODEL S21 PORTABLE MOUNTING FRAME (ASM DWG. NO. C31521G1).

DEFINITION: OPTION -02 CONSTITUTES THE ADDITION OF REAR PANEL MOUNTED BNC CONNECTORS FOR CONNECTION OF OUTPUT AND SERVO OUTPUT OF THE MODEL 461 AMPLIFIER.

GENERAL: CONTAINED HEREIN IS A LIST OF ITEMS TO BE DELETED FROM THE UNIT, A LIST OF REPLACEMENT ITEMS, AND A LIST OF INSTRUCTIONS.

REFERENCE DWG'S:

D41106G1,ASM, RACK MOUNTING FRAME MODEL S11
C31521G1,ASM, PORTABLE MOUNTING FRAME MODEL S21
D41084 ELEM DIAG, MOUNTING FRAME
C31729G1 ASM, REAR PANEL (S11-02)
C31728 REAR PANEL (S11-02)
A11453 R.L., REAR PANEL ASM (S11-02)
C31731G1 ASM, REAR PANEL (S21-02)
C31730 REAR PANEL (S21-02)
B22185 ANGLE BRACKET (S21-02)
A11454 R.L., REAR PANEL ASM (S21-02)

FIGURE 6.6 S SERIES CASE – OPTION 02 – MODIFICATION INSTRUCTIONS – SH 1

ASSEMBLY INSTRUCTIONS

MOUNTING FRAME OPTION-02

LIST OF ITEMS TO BE DELETED

FROM MODEL S11
ASM DWG. NO. D41106G1

ITEM	IDENT	DESCRIPTION	QTY
8	C31523P1	PANEL, REAR	1
10	A10447P1	LABEL	1

FROM MODEL S21
ASM DWG NO. C31521G1

12	B22018P1	PANEL, REAR	1
13	A10447P1	LABEL	1

LIST OF REPLACEMENT ITEMS

TO MODEL S11
ASM DWG NO. D41106G1

8	C31729G1	ASM, REAR PANEL	1
10	A10447P1	LABEL	1

TO MODEL S21
ASM DWG NO. C31521G1

12	C31731G1	ASM, REAR PANEL	1
13	A10447P1	LABEL	1

ITHACO DWG A11455, SH 2, 9/73

FIGURE 6.6 S SERIES CASE – OPTION 02 – MODIFICATION INSTRUCTIONS – SH 2

INSTRUCTIONS

FOR MODEL S11 ASM DWG NO. D41106G1
(FOR ASSEMBLY VIEWS SEE D41106&C31729)

A. REMOVE REAR PANEL (C31525P1) AND REPLACE WITH REAR PANEL ASSEMBLY DWG. NO. C31729G1.

B. WIRE PER RUNNING LIST A11453 "TO" END.

C. REPLACE REAR LABEL (A10447P1) WITH NEW LABEL RE DESIGNATING UNIT AS MODEL S11-02.

FOR MODEL S21 ASM DWG NO. C31521G1
(FOR ASSEMBLY VIEW SEE C31521&C31731)

A. REMOVE REAR PANEL (B22018P1) AND REPLACE WITH REAR PANEL ASSEMBLY DWG. NO. C31731G1.

B. WIRE PER RUNNING LIST A11454 "TO" END.

C. REPLACE REAR LABEL (A10447P1) WITH NEW LABEL RE DESIGNATING UNIT AS MODEL S21-02.

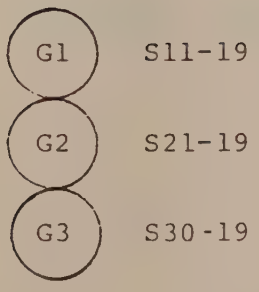
FIGURE 6.6 S SERIES CASE – OPTION 02 – MODIFICATION INSTRUCTIONS – SH 3

ASSEMBLY INSTRUCTIONS
MODEL S11, S21 MOUNTING FRAME
WITH AMPLIFIER REMOTE GAIN CONTROL OPTION 19

SCOPE: THIS DOCUMENT IS ESTABLISHED AS A SOURCE OF OF INFORMATION FOR THE PURPOSE OF ADDING AN OPTION TO A MODEL S11, S21 or S30 MOUNTING FRAME. THIS OPTION IS FOR USE WITH MODEL 450 SERIES AMPLIFIERS WITH 5dB MANUAL/REMOTE GAIN CONTROL OPTION 26 AND 10dB MANUAL/REMOTE GAIN CONTROL OPTION 19.

DEFINITION: THE MOUNTING FRAME WITH OPTION 19 DIFFERS FROM THE STANDARD IN THAT THE STANDARD WIRING (EXCEPT +15V, -15V, -55V AND PREAMP POWER AND THE PRIMARY S30 WIRING) IS REPLACED BY WIRING THRU WHICH THE GAIN OF A MODEL 450 SERIES AMPLIFIER WITH OPTION 19 OR OPTION 26 MAY BE CONTROLLED FROM A REMOTELY LOCATED MODEL 450C1 (10dB) OR MODEL 450C2 (5dB) GAIN CONTROL UNIT (VIA REAR PANEL AUXILIARY CONNECTOR) OR MAY BE CONTROLLED FROM A MODEL 450C1 OR 450C2 PLUGGED INTO THE MOUNTING FRAME WITH THE AMPLIFIERS. FOR CONNECTION OF A REMOTELY LOCATED MODEL 450C1 OR 450C2 A MODEL 450V2 CONNECTION CABLE MAY BE USED.

GENERAL: THE MOUNTING FRAME WITH OPTION 19 IS MECHANICALLY IDENTICAL WITH THE STANDARD, ONLY THE WIRING DIFFERS. FOR INSTRUCTIONS, SEE SHEET 2.



ITHACO DWG A11502, SH 1, REV B, 6/81

FIGURE 6.7 S SERIES CASE – OPTION 19 – MODIFICATION INSTRUCTIONS – SH 1

ASSEMBLY INSTRUCTIONS
MODEL S11, S21 MOUNTING FRAME
WITH AMPLIFIER REMOTE GAIN CONTROL OPTION 19

G1

INSTRUCTIONS

MODEL S11 (ASM DWG. NO. D41106 G1)

A.) ASSEMBLE ALL HARDWARE USING DOCUMENTATION FOR A MODEL S11 MOUNTING FRAME.

B.) WIRE PER R.L. A11503. FOR ELEM DIAG SEE D41434.

G2

C.) ON REAR PANEL SERIAL LABEL TYPE-IN MODEL NO. S11-19 AND SERIAL NO.

MODEL S21 (ASM DWG. NO. C31521 G1)

A.) ASSEMBLE ALL HARDWARE USING DOCUMENTATION FOR A MODEL S21 MOUNTING FRAME.

B.) WIRE PER R.L. A11504. FOR ELEM DIAG SEE D41434.

G3

C.) ON REAR PANEL SERIAL LABEL TYP-IN MODEL NO. S21-19 AND SERIAL NO.

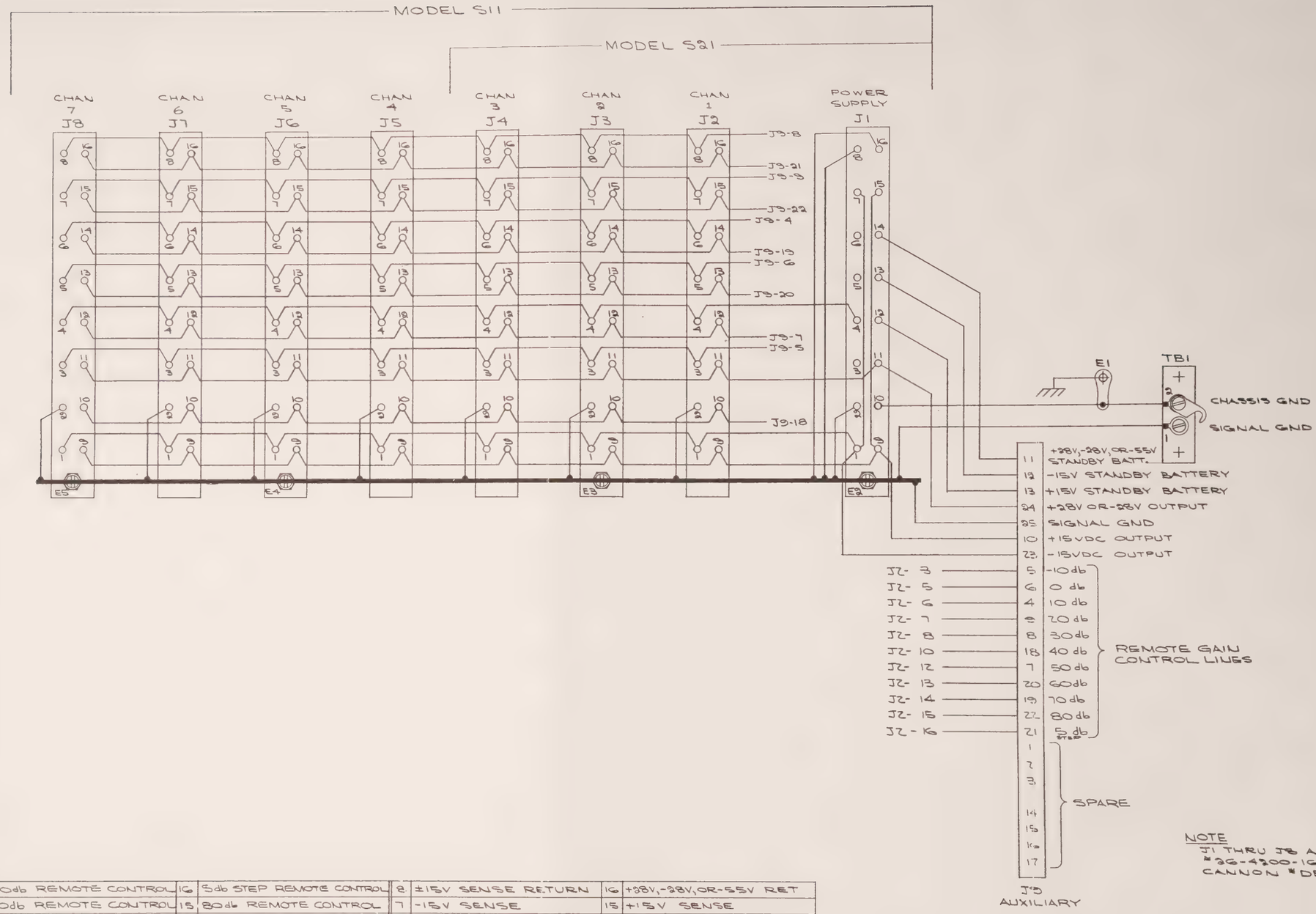
MODEL S30 (ASM DWG NO. C31789 G1)

A.) ASSEMBLE ALL HARDWARE USING DOCUMENTATION FOR A MODEL S30 MOUNTING FRAME.

B.) WIRE PER R.L. A11505. FOR ELEM DIAG SEE D41435.

C.) ON REAR PANEL SERIAL LABEL TYPE IN MODEL NO. S30-19 AND SERIAL NO.

FIGURE 6.7 S SERIES CASE – OPTION 19 – MODIFICATION INSTRUCTIONS – SH 2



NOTE
J1 THRU J8 ARE AMPHENOL #36-4300-169, J9 IS CANNON #DBM-25P.

PIN	FUNCTION	PIN	FUNCTION
8	30db REMOTE CONTROL	16	5db STEP REMOTE CONTROL
7	20db REMOTE CONTROL	15	80db REMOTE CONTROL
6	10db REMOTE CONTROL	14	70db REMOTE CONTROL
5	0 db REMOTE COUTROL	13	60db REMOTE CONTROL
4	-55 VDC	12	50db REMOTE CONTROL
3	-10db REMOTE CONTROL	11	PREAMP POWER
2	SIGNAL GND	10	40db REMOTE CONTROL
1	-15VDC	9	+15VDC

J2 THRU J8 PIN ASSIGNMENT

PIN	FUNCTION	PIN	FUNCTION
8	±15V SENSE RETURN	16	+38V,-28V,OR-55V RET
7	-15V SENSE	15	+15V SENSE
6	CAL RELAY POWER	14	+38V,-28V,OR -55V *STANDBY BATT
5	CAL RELAY RETURN	13	-15V STANDBY BATT
4	-55VDC	12	+15V STANDBY BATT
3	CAL OSC	11	PREAMP POWER
2	SIGNAL GND	10	POWER GND
1	-15VDC	9	+15VDC

J1 PIN ASSIGNMENT

ITHACO DWG D41434, SH 1, REV A, 4/74

FIGURE 6.8
S SERIES CASE – OPTION 19
WIRING DIAGRAM

ASSEMBLY INSTRUCTIONS
MODEL S11, S21 MOUNTING FRAME
WITH AMPLIFIER STATUS READOUT OPTION 23

SCOPE: This document is established as a source of information for the purpose of adding an option to a model S11, S21, or S30 Mounting Frame. This Option is for use with Model 450 series Amplifiers with Status Readout Options 20 thru 23.

DEFINITION: The Mounting Frame with option 23 differs from the standard in that the standard wiring (except +15V,-15V, and -55V and the primary S30 wiring) is replaced by wiring through which the status of the Amplifiers 10dB Gain Switch, 1dB Gain Switch & LFRO Switch, are brought out encoded in a Binary format in 11 lines plus a Strobe for each channel. For Binary coding format see A11475 sheet 17.

GENERAL: The Mounting Frame with option 23 is mechanically identical with the standard, only the wiring differs. For instructions, see sheet 2.

FIGURE 6.9 S SERIES CASE – OPTION 23 – MODIFICATION INSTRUCTIONS – SH 1

ASSEMBLY INSTRUCTIONS
MODEL S11, S21 MOUNTING FRAME
WITH AMPLIFIER STATUS READOUT OPTION 23

INSTRUCTIONS

(-1) MODEL S11 (ASM DWG. NO. D41106 G1)

A.) Assemble all hardware using documentation for a Model S11 Mounting Frame.

B.) Wire per RL A11480. For Elem Diag. see D41368.

C.) On Rear Panel serial label type-in Model No. S11-23 and serial No.

(-2) MODEL S21 (ASM, DWG NO. C31521 G1)

A,) Assemble all hardware using documentation for a Model S21 Mounting Frame.

B.) Wire per RL A11481. For Elem Diag. see D41368.

C.) On Rear Panel serial label type-in Model No. S21-23 and serial No.

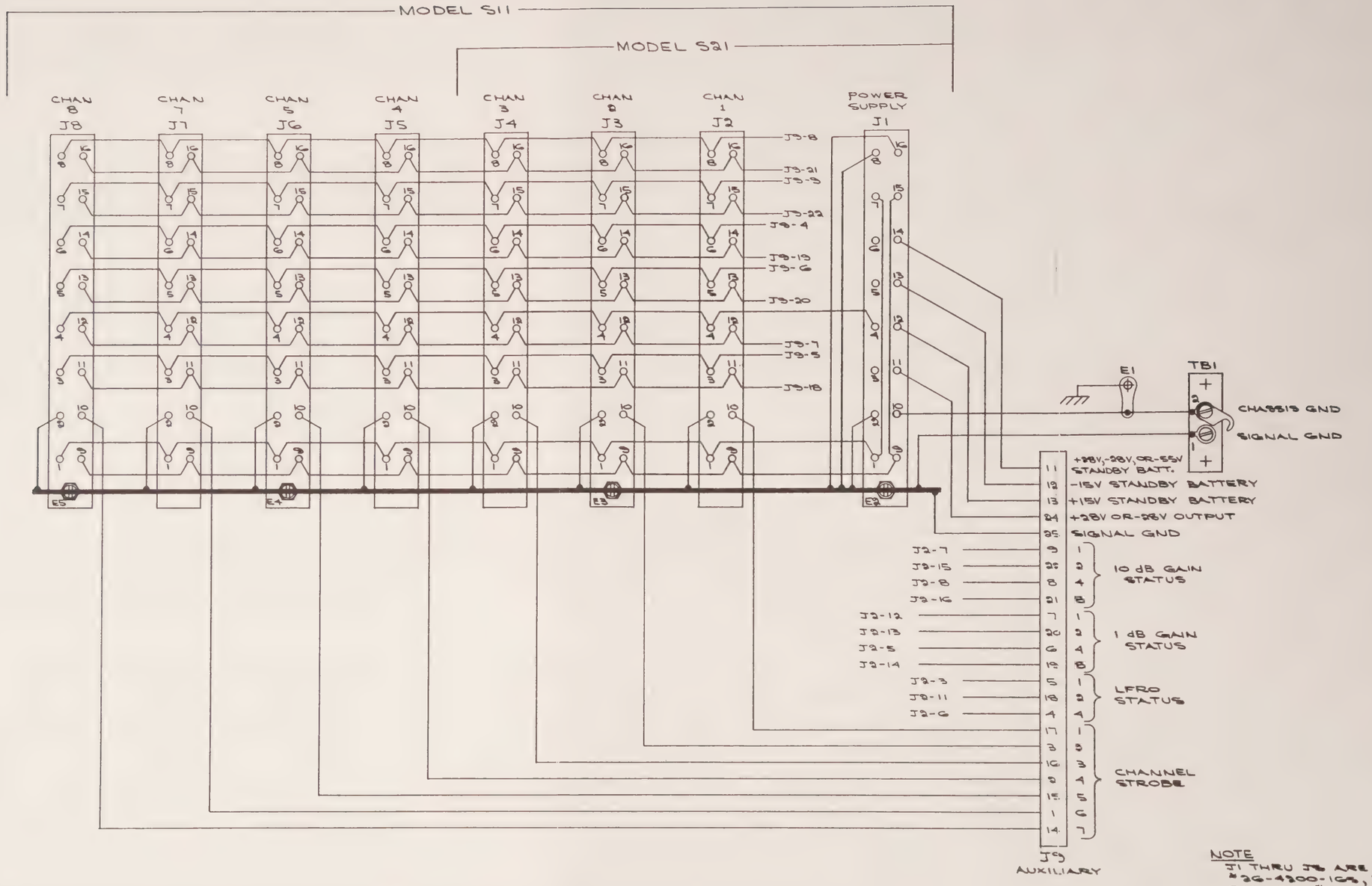
(-3) MODEL S30 (ASM DWG NO. C31789G1)

A.) Assemble all hardware using documentation for a Model S30 Mounting Frame.

B.) Wire per RL A11482. For Elem Diag. see D41370.

C.) On Rear Panel serial label type-in Model No. S30-23 and serial No.

FIGURE 6.9 S SERIES CASE – OPTION 23 – MODIFICATION INSTRUCTIONS – SH 2



NOTE
J1 THRU J8 ARE AMPHENOL #26-4300-105, J9 IS CANNON #DBM-25P.

PIN	FUNCTION	PIN	FUNCTION
J8 THRU J8 PIN ASSIGNMENT			
8	10 dB GAIN STATUS 4	16	10 dB GAIN STATUS 8
7	10 dB GAIN STATUS 1	15	10 dB GAIN STATUS 2
6	LFRO STATUS 4	14	1 dB GAIN STATUS 8
5	1 dB GAIN STATUS 4	13	1 dB GAIN STATUS 2
4	-28 VDC	12	1 dB GAIN STATUS 1
3	LFRO STATUS 1	11	LFRO STATUS 2
2	SIGNAL GND	10	CHANNEL STROBE
1	-15 VDC	9	+15 VDC

PIN	FUNCTION	PIN	FUNCTION
J1 PIN ASSIGNMENT			
8	±15V SENSE RETURN	16	+28V,-28V,OR-55V RET
7	-15V SENSE	15	+15V SENSE
6	CAL RELAY POWER	14	+28V,-28V, OR -55V STANDBY BATT
5	CAL RELAY RETURN	13	-15V STANDBY BATT
4	-55 VDC	12	+15V STANDBY BATT
3	CAL OSC	11	PREAMP POWER
2	SIGNAL GND	10	POWER GND
1	-15 VDC	9	+15 VDC

ITHACO DWG D41368, SH 1, 12/73

FIGURE 6.10
S SERIES CASE – OPTION 23
WIRING DIAGRAM

ASSEMBLY INSTRUCTIONS
MODEL S11 MOUNTING FRAME
WITH REMOTE PROGRAMMING OPTION 27

SCOPE: THIS DOCUMENT IS ESTABLISHED AS A SOURCE OF INFORMATION FOR THE PURPOSE OF ADDING AN OPTION 27 TO THE S11 MOUNTING FRAME. THIS OPTION IS FOR USE WITH 450 SERIES AMPLIFIERS WITH THE REMOTE PROGRAMMING OPTION 27.

DEFINITION: THE MOUNTING FRAME WITH OPTION 27 DIFFERS FROM THE STANDARD S11 FRAME IN THAT THE STANDARD WIRING (EXCEPT THE POWER SUPPLY WIRING) IS REPLACED BY WIRING THROUGH WHICH THE STATUS OF THE AMPLIFIER GAIN AND IF APPLICABLE, ROLLOFF, ARE BROUGHT OUT ON BI-DIRECTIONAL LINES ENCODED IN A COMPLIMENTED BINARY CODED DECIMAL FORMAT. A READ/WRITE LINE, LOGIC GROUND, AND COMPLIMENTED STROBE LINE FOR EACH CHANNEL ARE ALSO BROUGHT OUT ON THE J9 AUXILIARY CONNECTOR.

GENERAL: THE J9 CONNECTOR CAN BE DIRECTLY INTERFACED WITH AN ITHACO 488A-2 COUPLER WHICH CONVERTS THE DATA LINES TO AN IEEE 488 BUSS FORMAT TO ENABLE COMPUTERS EQUIPPED WITH A 488 PORT TO INTERFACE WITH THE 450 SYSTEM.

REFERENCE DRAWINGS:

D41106G1	ASSEMBLY RACK MOUNTING FRAME
D42576	ELEMENTARY DIAGRAM S11-27

FIGURE 6.11 S SERIES CASE – OPTION 27 – ASSEMBLY INSTRUCTIONS – SH 1

ASSEMBLY INSTRUCTIONS
MODEL S11 MOUNTING FRAME
WITH REMOTE PROGRAMMING OPTION 27

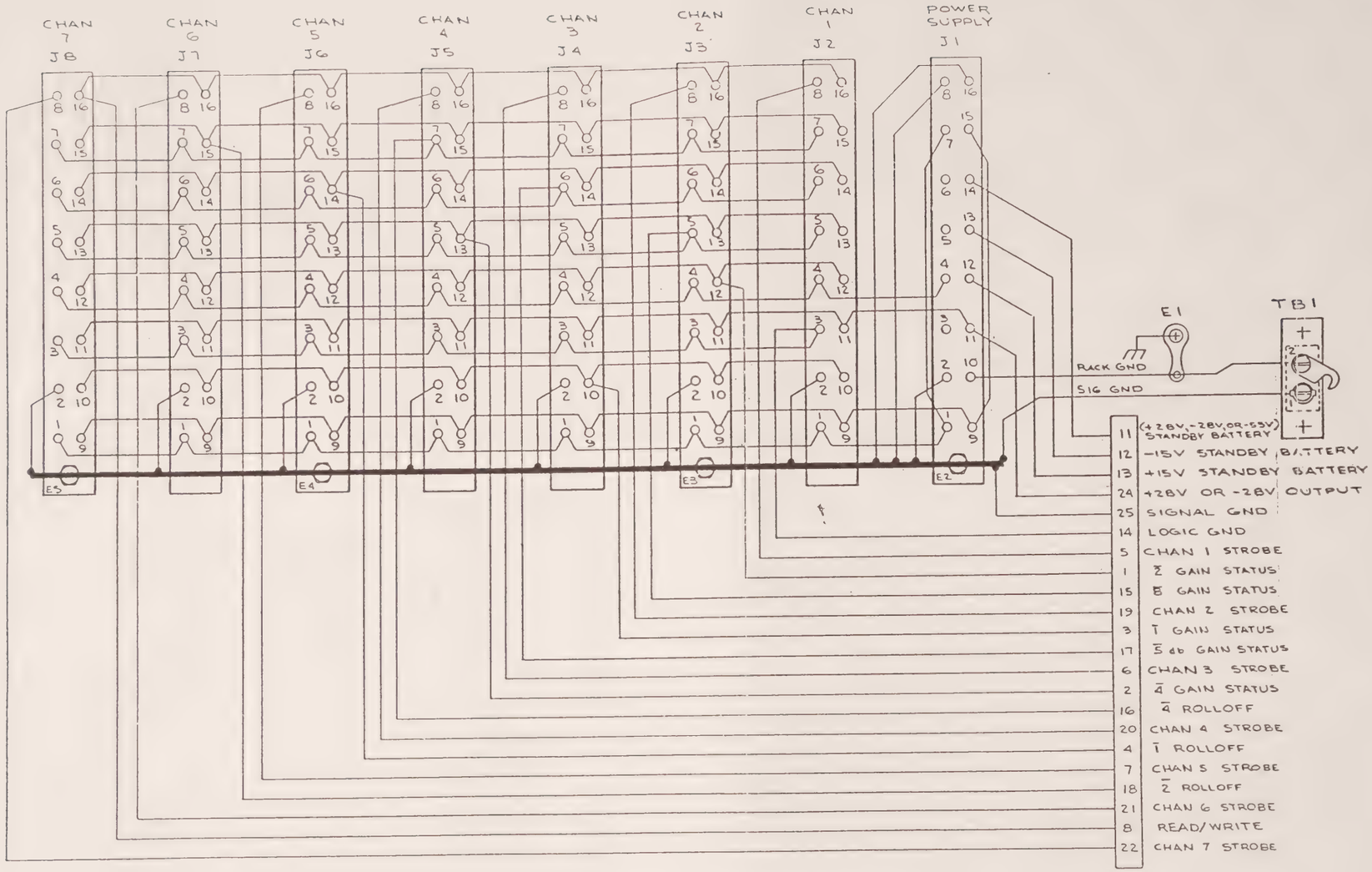
MODEL S11 (Assembly Drawing D41106G1)

A. ASSEMBLY ALL HARDWARE USING DOCUMENTATION FOR A MODEL S11 MOUNTING FRAME.

B. WIRE PER RUNNING LIST A12661. FOR ELEMENTARY DIAGRAM, SEE D42576, SHEET 1.

C. ON REAR PANEL SERIAL NUMBER, TYPE IN MODEL NUMBER S11-27 AND SERIAL NUMBER.

FIGURE 6.11 S SERIES CASE – OPTION 27 – ASSEMBLY INSTRUCTIONS – SH 2



NOTES:

1. J1 THRU J8 ARE AMPHENOL #26-4200-165
   J9 IS CANNON DBM-25D

PIN	FUNCTION	PIN	FUNCTION
8	STROBE	16	READ/WRITE
7	4 ROLLOFF STAT.	15	2 ROLLOFF STAT
6	5 db GAIN STATUS	14	1 ROLLOFF STATUS
5	8 GAIN STATUS	13	4 GAIN STATUS
4	-55 VDC	12	2 GAIN STATUS
3	LOGIC GND	11	+28 V
2	SIGNAL GND	10	1 GAIN STATUS
1	-15 VDC	9	+15 VDC

J2 THRU J8 PIN ASSIGNMENT

PIN	FUNCTION	PIN	FUNCTION
8	±15V SENSE RET	16	+28V,-28V,OR-55V RET
7	-15V SENSE	15	+15V SENSE
6	CAL RLY PWR	14	+28V,-28V OR -55V STANDBY BATT
5	CAL RLY RET	13	-15V STBY BATT.
4	-55 VDC	12	+15V STBY BATT.
3	CAL OSC	11	PREAMP PWR
2	SIGNAL GND	10	POWER GND
1	-15VDC	9	+15VDC

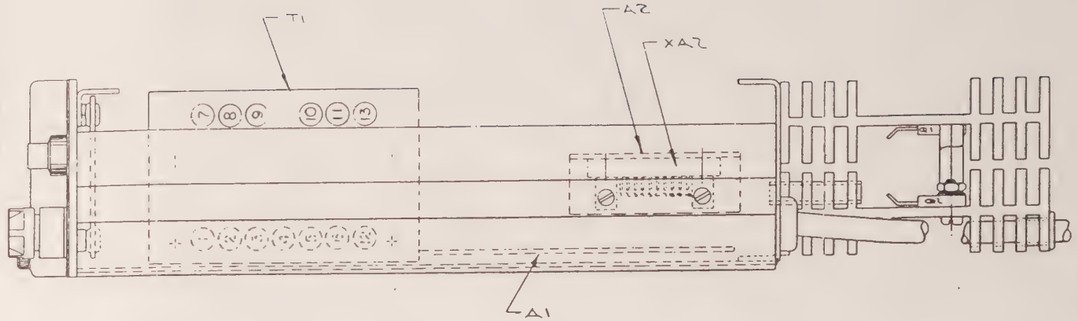
J1 PIN ASSIGNMENT

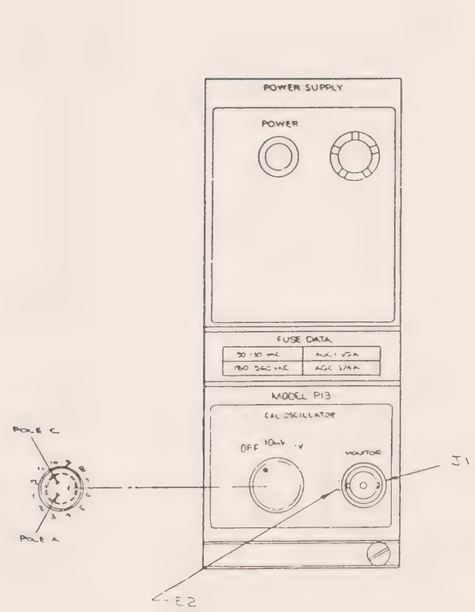
FIGURE 6.12
S SERIES CASE – OPTION 27
WIRING DIAGRAM

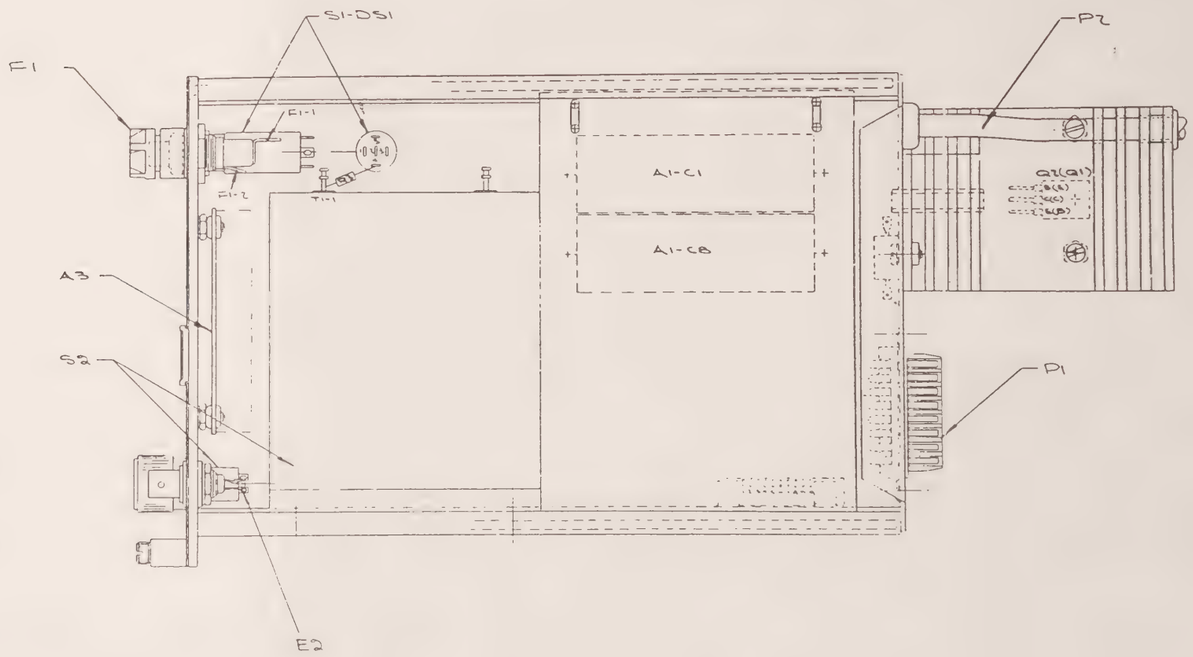
ITHACO DWG D42576, SH 1, 11/81

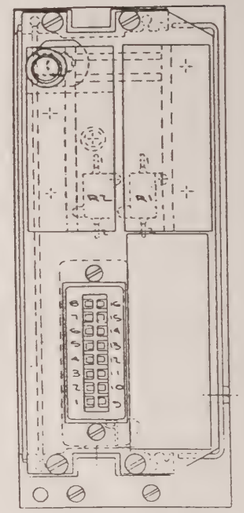
P1 PIN ASSIGNMENT

PIN NO	FUNCTION	USED IN MODEL						
		P11	P12	P13	P14	P17	P15	P16
1	-15V	X	X	X	X	X	X	X
2	SIGNAL GND	X	X	X	X	X	X	X
3	CAL (OUTPUT)			X		X		X
4	-55V				X			
5	CAL RELAY RET			X		X		X
6	CAL RELAY PWR			X		X		X
7	-15V SENSE	X	X	X	X	X	X	X
8	±15V RET SENSE	X	X	X	X	X	X	X
9	+15V	X	X	X	X	X	X	X
10	CHASSIS (RACK) GND	X	X	X	X	X	X	X
11	PREAMP PWR		+28V	+28V			+18V	-28V
12	+15V STANDBY BATT	X	X	X	X	X	X	X
13	-15V STANDBY BATT	X	X	X	X	X	X	X
14	PREAMP PWR STANDBY BATT		X	X	X		X	X
15	+15V SENSE	X	X	X	X	X	X	X
16	PREAMP PWR RET -55V RET	X	X	X	X	X	X	X



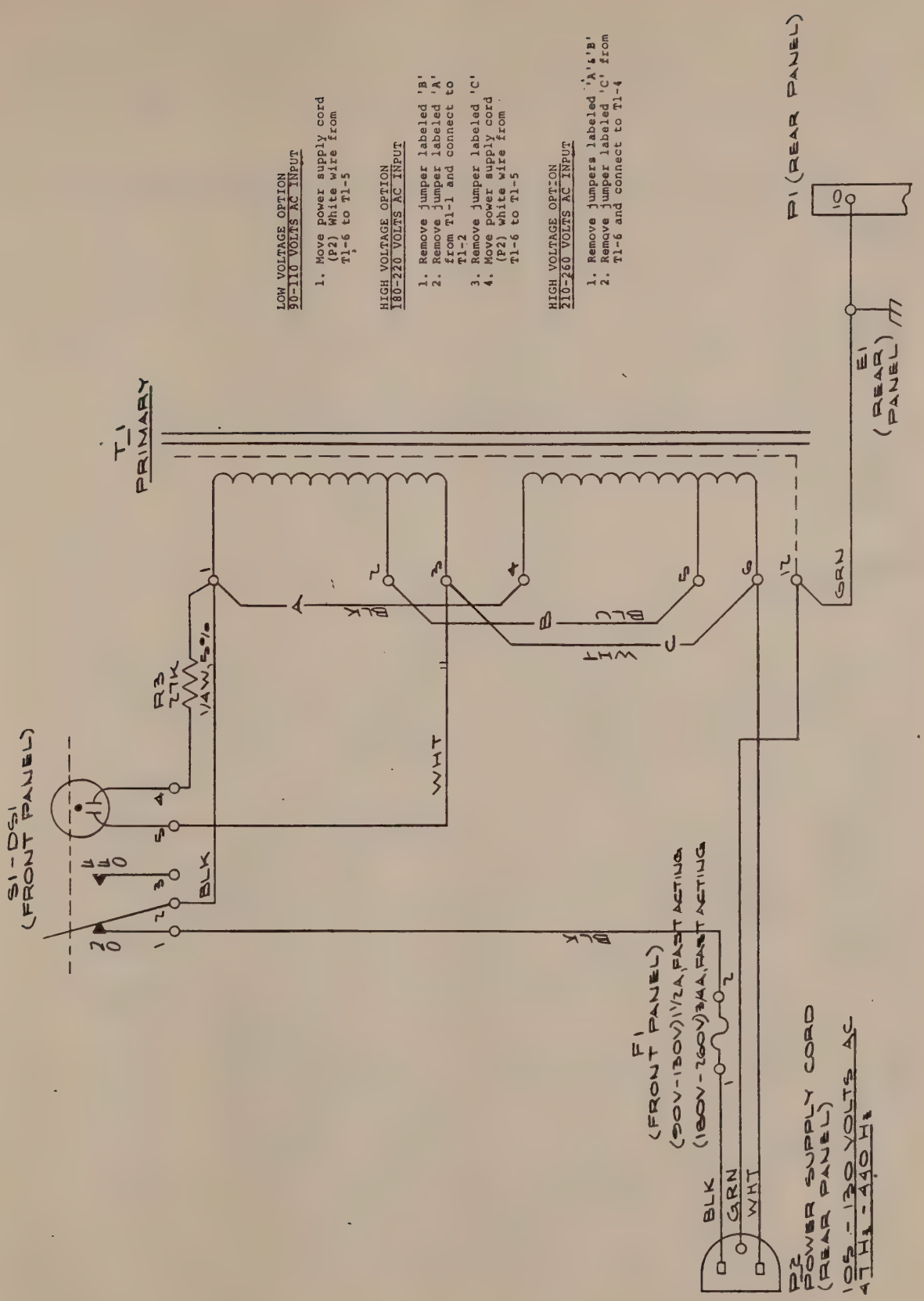






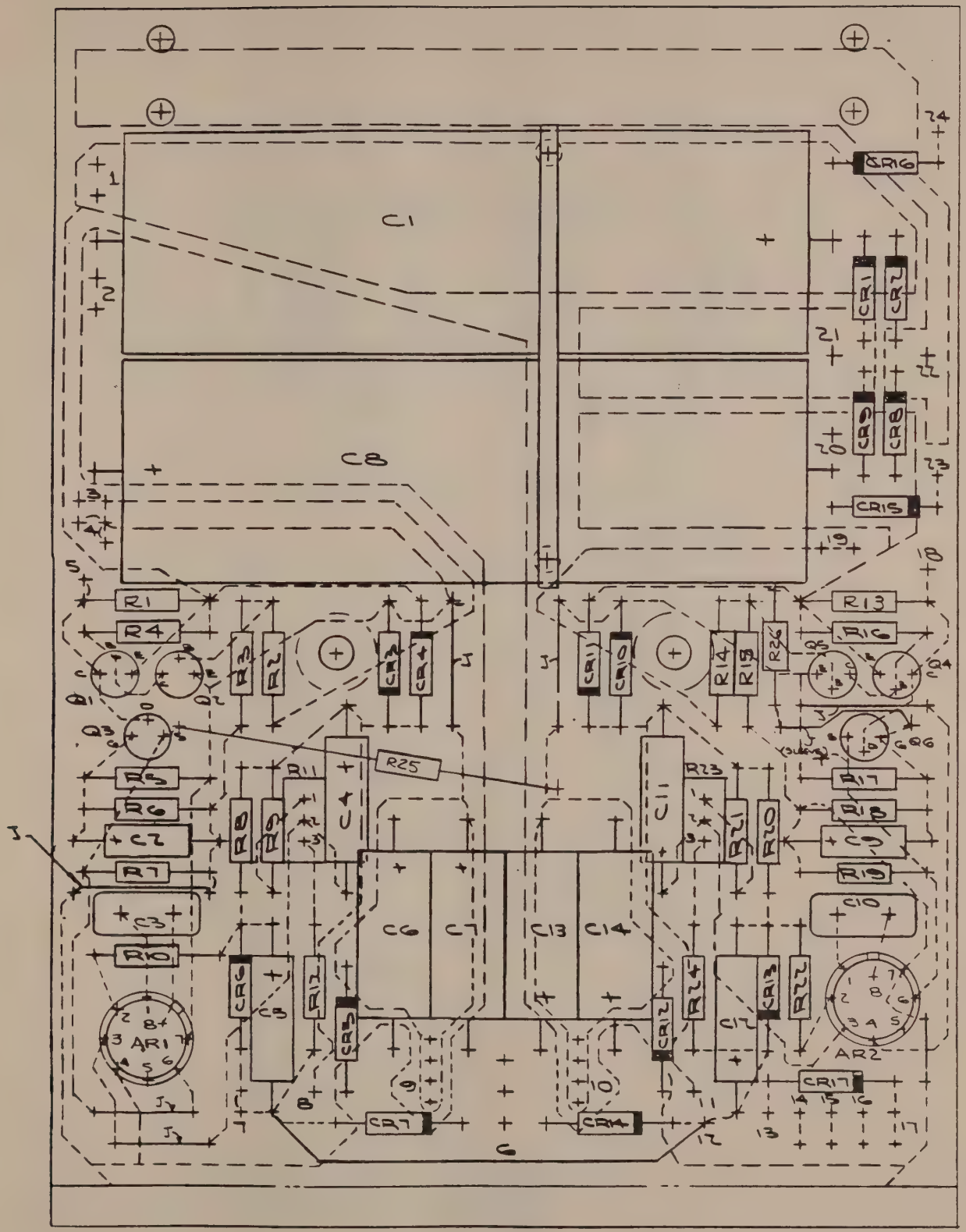
ITHACO DWG D41566, SH 1, REV B, 10/75

FIGURE 6.13
P SERIES POWER SUPPLY
ASSEMBLY


LOW VOLTAGE OPTION
90-110 VOLTS AC INPUT
1. Move power supply cord (P2) White wire from T1-6 to T1-5
HIGH VOLTAGE OPTION
180-220 VOLTS AC INPUT
1. Remove jumper labeled 'B'
2. Remove jumper labeled 'A' from T1-1 and connect to T1-2
3. Remove jumper labeled 'C'
4. Move power supply cord (P2) white wire from T1-6 to T1-5
HIGH VOLTAGE OPTION
210-260 VOLTS AC INPUT
1. Remove jumpers labeled 'A' & 'B'
2. Remove jumper labeled 'C' from T1-6 and connect to T1-4
T1 PRIMARY
P1 (REAR PANEL)
E1 (REAR PANEL)
S1-DS1 (FRONT PANEL)
R3 27K 1/4W, 5%
BLK
WHT
GRN
F1 (FRONT PANEL)
(90V-130V) 1/2A, FAST ACTING
(180V-260V) 3/4A, FAST ACTING
P2 POWER SUPPLY CORD (REAR PANEL)
105-130 VOLTS AC
47Hz-440Hz

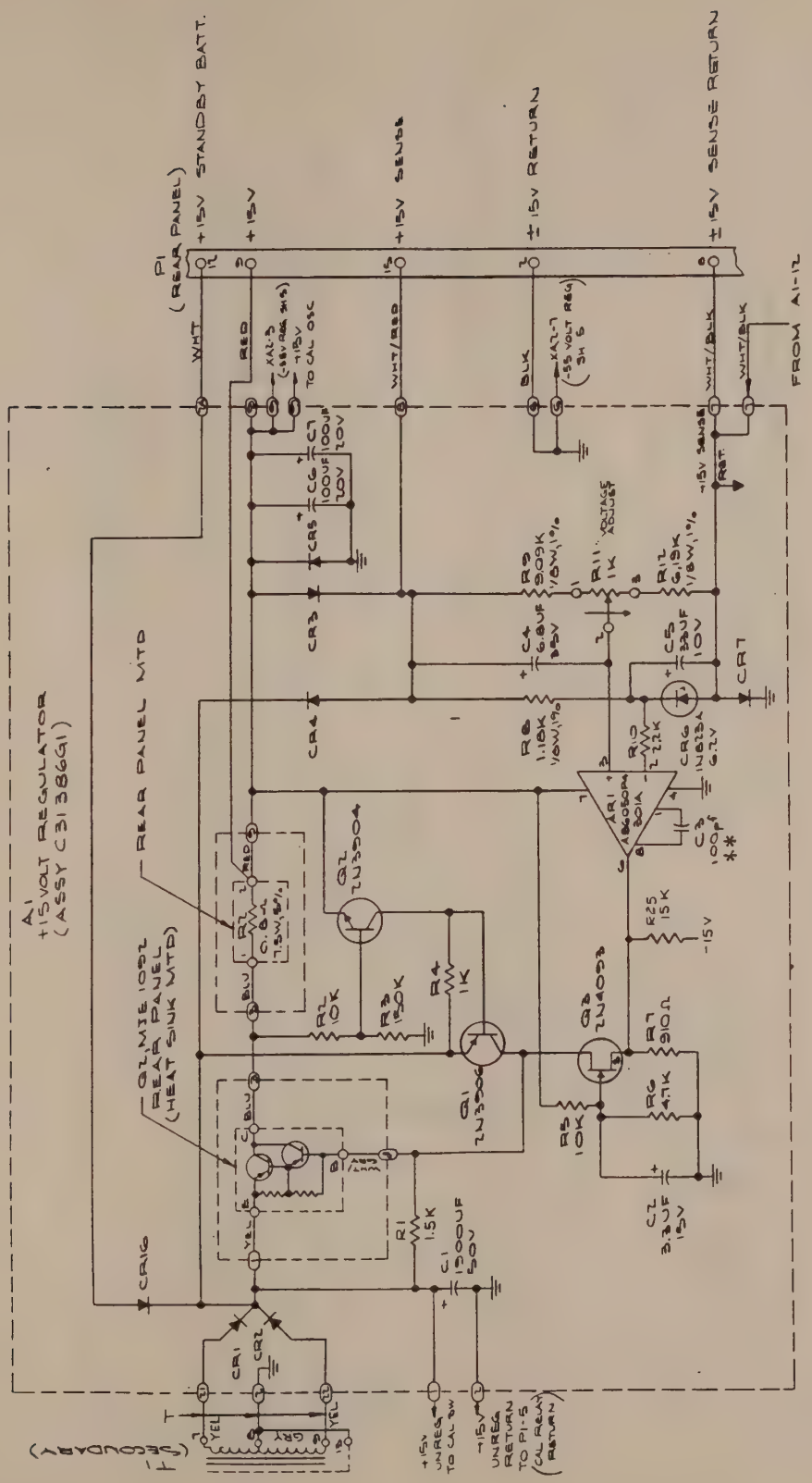
ITHACO DWG C31408, SH 1, REV B, 4/72

FIGURE 6.14 P SERIES POWER SUPPLY – PRIMARY POWER WIRING



ITHACO DWG C31386, SH 1, REV F, 9/76

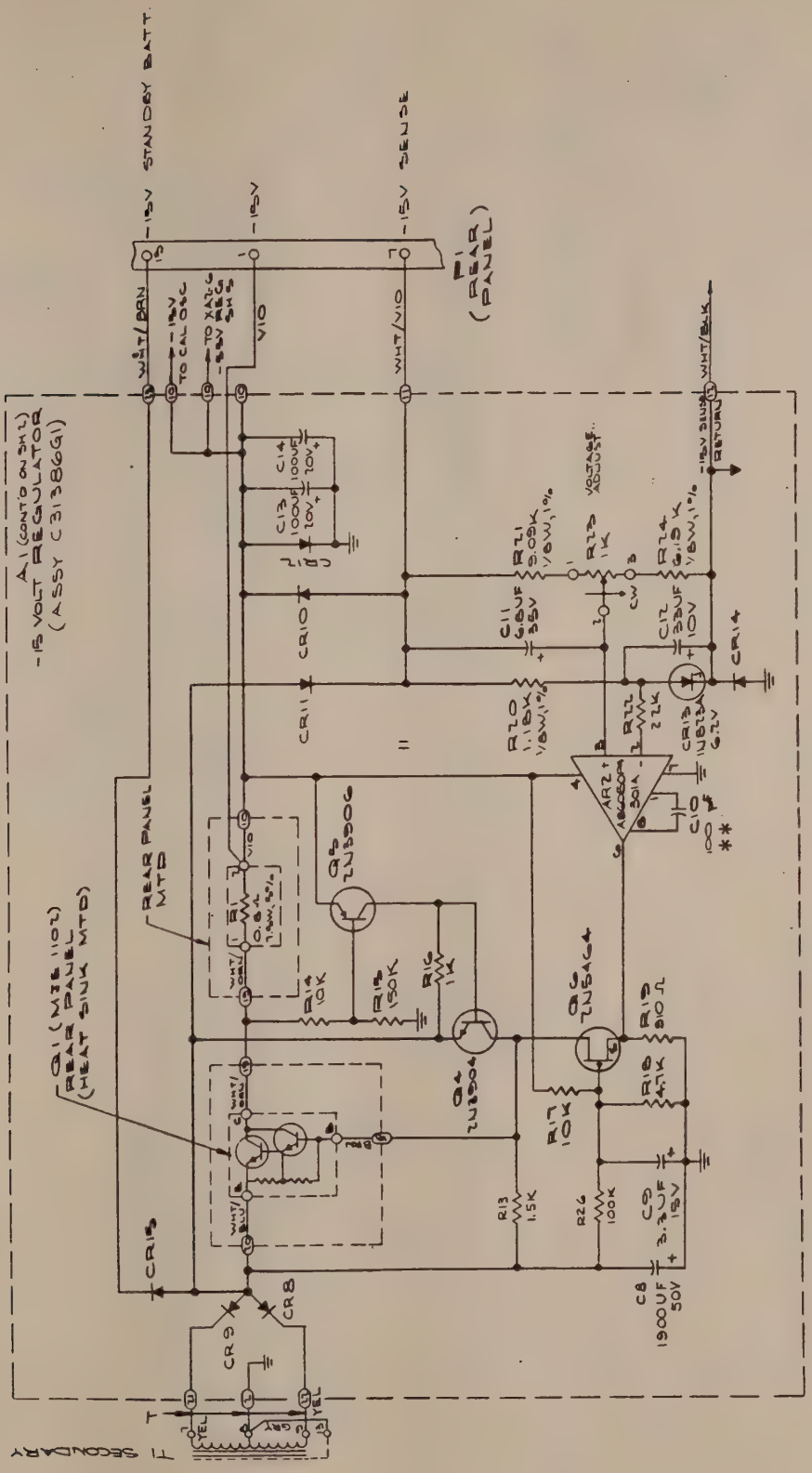
FIGURE 6.15 P SERIES POWER SUPPLY –15V/+15 VOLT REGULATOR – ASSEMBLY



** Values may change at test level to 220pF.

ITHACO DWG C31408, SH 2, REV L, 6/78

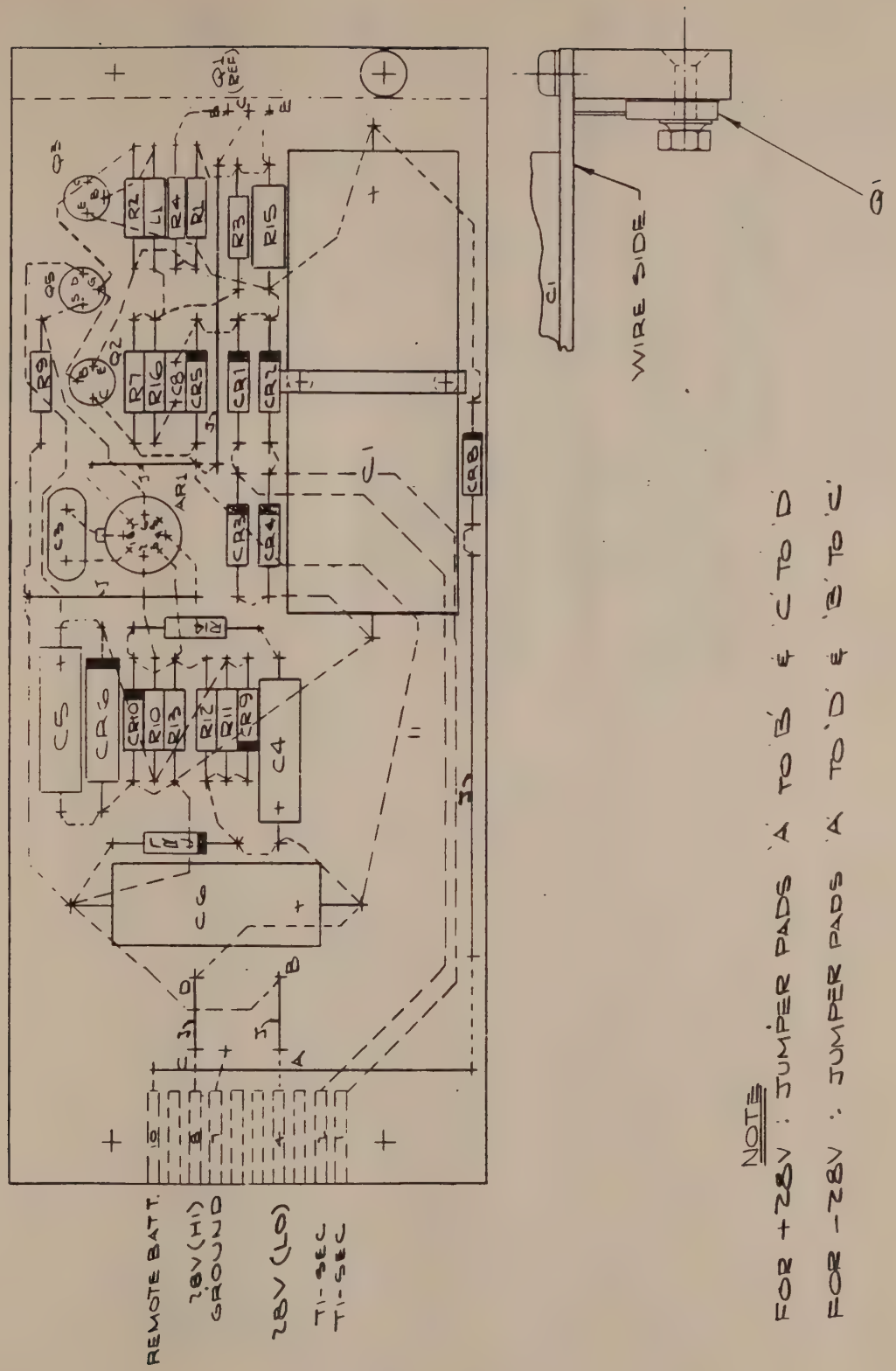
FIGURE 6.16 P SERIES POWER SUPPLY – +15 VOLT REGULATOR – SCHEMATIC



**Values may change at test level to 220pF.

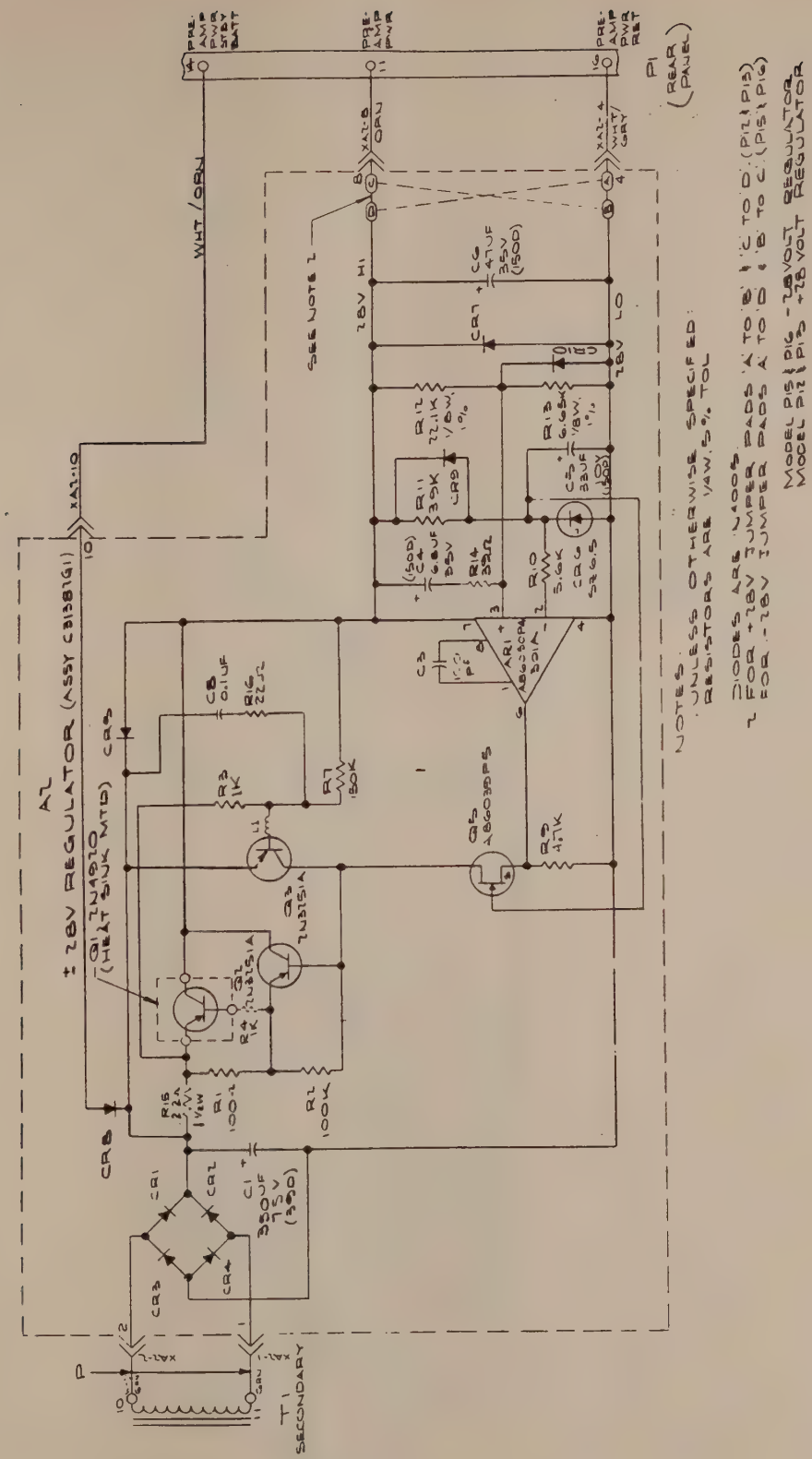
ITHACO DWG C31408, SH 3, REV M, 7/78

FIGURE 6.17 P SERIES POWER SUPPLY – –15 VOLT REGULATOR – SCHEMATIC



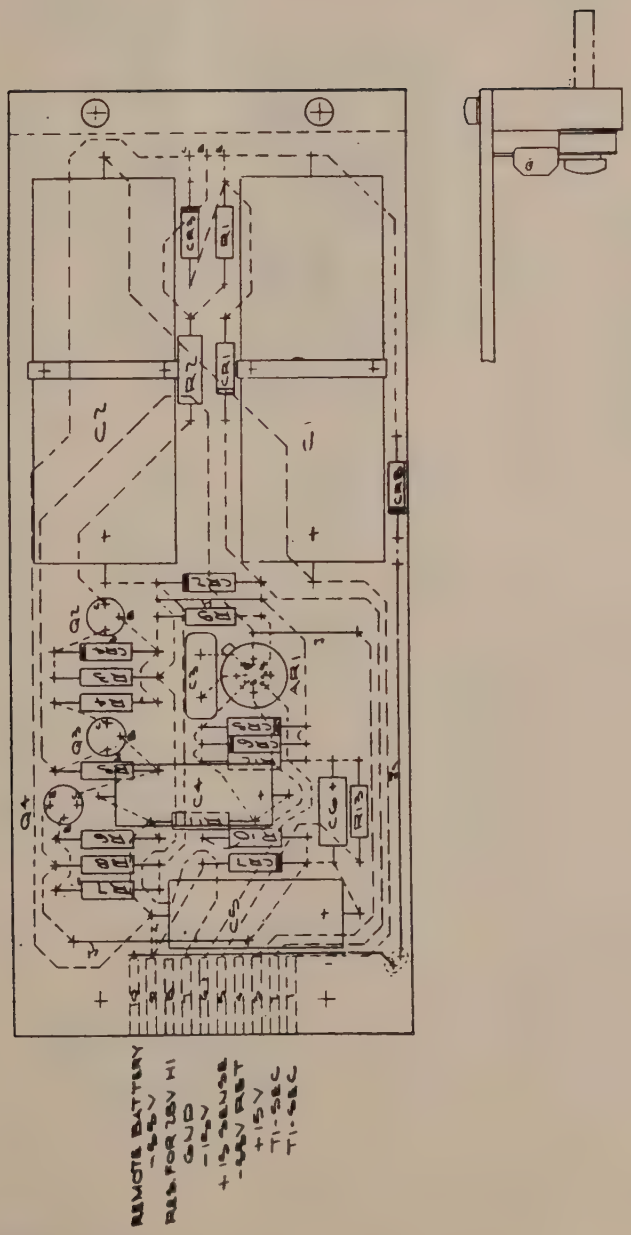
ITHACO DWG C31387, SH 1, REV H, 1/78

FIGURE 6.18 P SERIES POWER SUPPLY – ±28 VOLT REGULATOR – ASSEMBLY



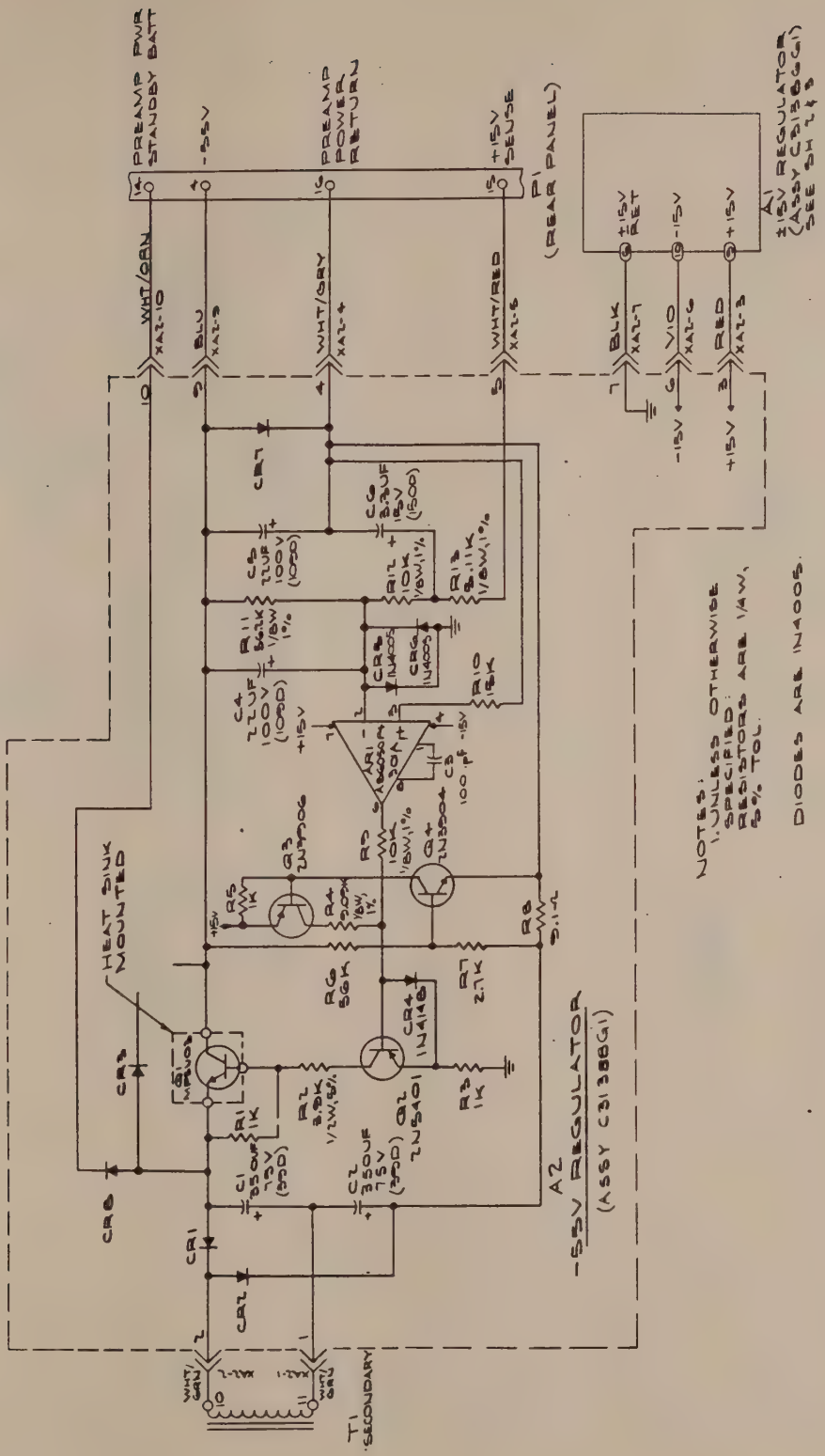
ITHACO DWG C31408, SH 4, REV L, 1/78

FIGURE 6.19 P SERIES POWER SUPPLY –28/+28 VOLT REGULATOR – SCHEMATIC



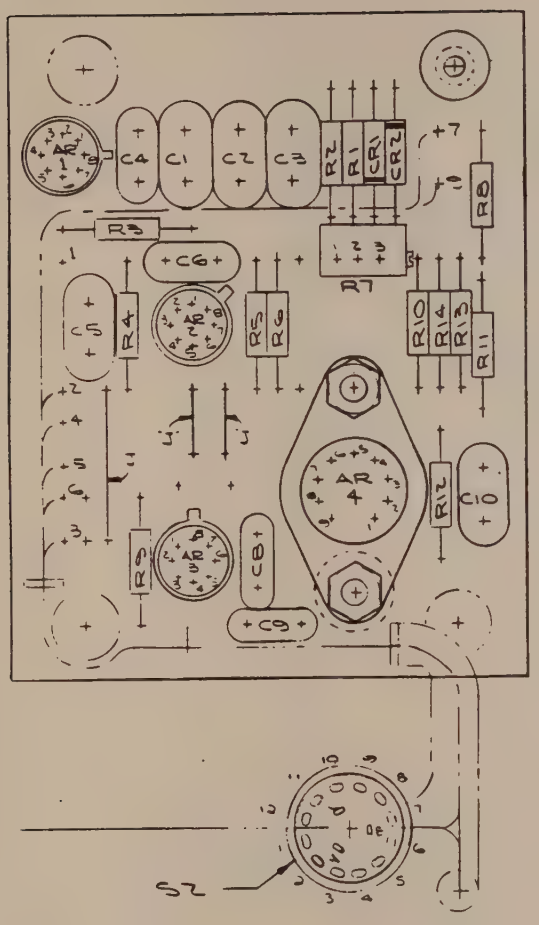
ITHACO DWG C31388, SH 1, REV A, 8/79

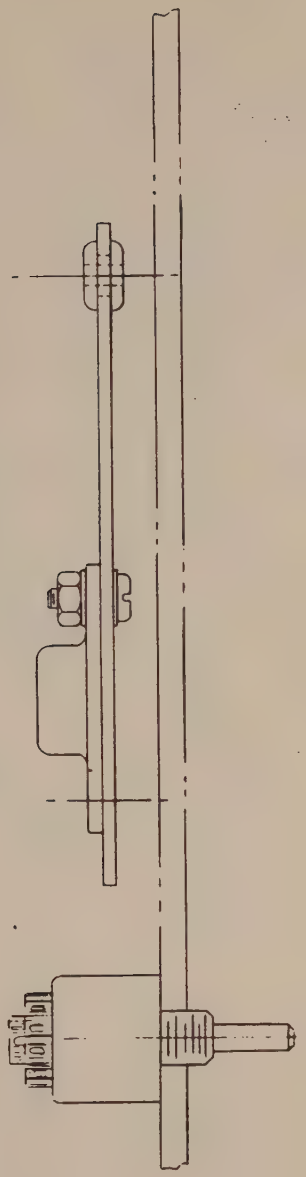
FIGURE 6.20 P SERIES POWER SUPPLY –55 VOLT REGULATOR – ASSEMBLY



ITHACO DWG C31408, SH 5, REV E, 4/72

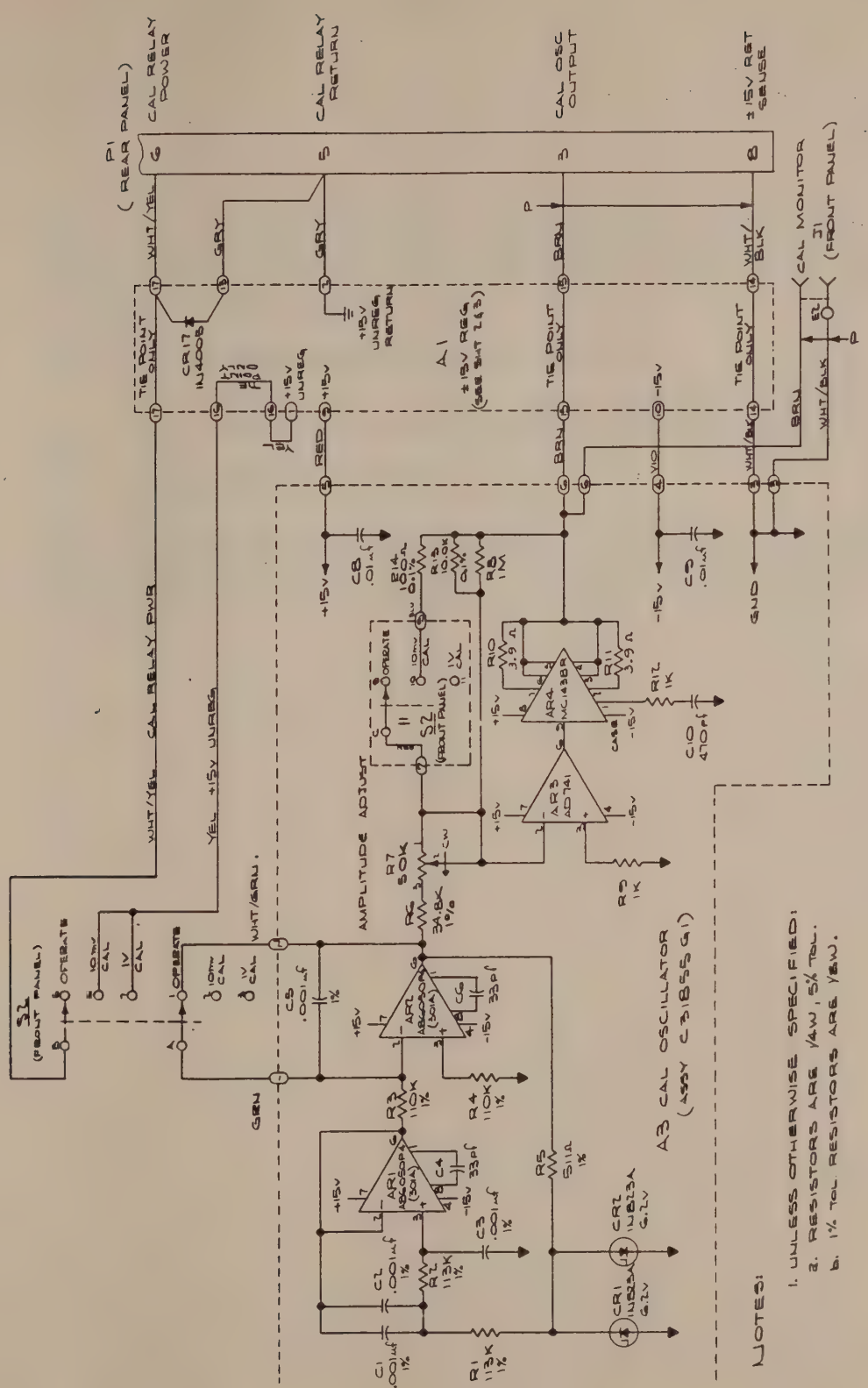
FIGURE 6.21 P SERIES POWER SUPPLY –55 VOLT REGULATOR – SCHEMATIC





ITHACO DWG C31855, SH 1, REV B, 10/75

FIGURE 6.22 P SERIES POWER SUPPLY – CAL OSCILLATOR ASSEMBLY



ITHACO DWG C31408, SH 9, REV B, 10/75

FIGURE 6.23 P13, P16, P17 POWER SUPPLIES – CAL SYSTEM – SCHEMATIC

7.0 REPLACEABLE PARTS

7.1 INTRODUCTION

This section contains information for ordering replaceable parts. Tables list parts in alphabetical order of their reference designation and indicates the description and manufacturer's part number. When applicable, a typical manufacturer is indicated.

7.2 REFERENCE DESIGNATIONS AND ABBREVIATIONS

Table 7.1 is a list of reference designations and abbreviations.

7.3 CODE LIST OF MANUFACTURERS

Table 7.3 is a Code List of Manufacturers. The manufacturer's code is given with each part. If a code number is missing, the part is a standard designation and available from many manufacturers.

REFERENCE DESIGNATIONS

A	assembly subassembly, separable or repairable
AR	amplifier
AT	attenuator pad termination
B	blower motor synchro
BT	battery
C	capacitor
CB	circuit breaker
CP	adapter, connector coupling (aperture, loop or probe) junction (coaxial or waveguide)
CR	diode rectifier
DS	alarm indicator (excluding meter)
E	antenna arrester, lightning bimetallic strip cell, aluminum or electrolytic contact core, inductor core, memory core, transformer Hall effect device insulator loop antenna magnet, permanent part, miscellaneous electrical post, binding shield, electrical terminal (individual)
F	fuse
FL	filter
G	chopper, electronic generator
H	hardware
HR	heater lamp, infrared
HS	handset
HY	network, hybrid circuit
J	connector, receptacle, electrical disconnecting device jack receptacle (connector, stationary portion)
K	relay
L	coil (all not classified as transformers) inductor
M	clock counter, electrical meter oscillograph oscilloscope recorder, elapsed time register, message strain gage thermometer timer, electric
MK	microphone
MP	frame gyroscope interlock, mechanical mechanical part mounting (not electrical circuit, not a socket) part, miscellaneous mechanical (bearing, coupling, gear, shaft) part, structural reed, vibration tuning fork
MT	transducer transducer, mode
P	connector, plug, electrical disconnecting device (connector, plug)
	plug, electrical (connector, movable portion)
PS	power supply
Q	transistor
R	potentiometer resistor
RT	lamp, resistance resistor, current regulating resistor, thermal thermistor
RV	resistor, voltage sensitive varistor, symmetrical
S	switch thermostat
T	transformer
TB	strip, terminal terminal board
TC	thermocouple
TP	test point
U	integrated circuit package
V	cell, light-sensitive, photo-emissive electron tube
W	cable cable assembly (with connectors) wire
WT	tiepoint, wiring
X	fuseholder lampholder socket
Y	crystal unit, piezoelectric

ABBREVIATIONS

A	ampere
AC	alternating current
ALUM	aluminum
AMPL	amplifier
ASSY	assembly
BP	bandpass
CAL	calibration
CAR	carbon
CCW	counterclockwise
CER	ceramic
CKT	circuit
COMP	composition
CRT	cathode-ray tube
CW	clockwise
dB	decibel
DC	direct current
DET	detector
DVM	digital voltmeter
ELECT	electrolytic
ENCAP	encapsulated
EXT	external
F	farads
FET	field effect transistor
FREQ	frequency
FXD	fixed
GE	germanium
GL	glass
GND	ground
H	henries
HPF	high-pass filter
HR	hour
Hz	hertz
IF	intermediate frequency
INS	insulation(ed)
INT	internal
K	kilo = 1000
LED	light emitting diode
LIN	linear taper
LOG	logarithmic taper
LPF	low-pass filter
M	Millo 10^{-3}
MEG	meg 10^{6}
METFLM	metal film
MFR	manufacturer
MINAT	miniature
MOM	momentary
MTG	mounting
MYFLM	"mylar" film
N	nano (10^{-3})
NC	normally closed
NE	neon
NO	normally open
NPO	negative positive zero
NSR	not separately replaceable
OSC	oscillator
OP	operational
PC	printed circuit
PF	picofarads 10^{12} farads
PIV	peak inverse volt voltage
P/P	part of
PPM	parts per million
POLY	polystyrene
POLYCARB	poly carbonate
POS	position(s)
POT	potentiometer
P-P	peak-to-peak
RC	resistor capacitor network
RECT	rectifier
REF	reference
RF	radio frequency
RMS	root-means-square
S-B	slow-blow
SCR	screw
SE	selenium
SEC	second
SECT	section(s)
SEMICON	semiconductor
SI	silicon
SIL	silver
SL	slide
SOL	solid
SPL	special
TA	tantalum
TGL	toggle
TOL	tolerance
TRIM	trimmer
μ	micro 10^{-6}
V	volt
VAR	variable
VDCW	dc working volts
VCO	voltage controlled oscillator
W/	with
W	watts
WW	wirewound
W/O	without

TABLE 7.1 LIST OF REFERENCE DESIGNATIONS AND ABBREVIATIONS

MODEL P11 ASSEMBLY D41566 G1

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	MANUFACTURER CODE	MANUFACTURER PART NUMBER
	BASIC ASSEMBLY	D41565G1		
A1	-15/+15V REGULATOR CARD ASM	C31386G1		
AR1	Op Amp LM301A	A86050P4	31	A86050P4
AR2	Op Amp LM301A	A86050P4	31	A86050P4
	CAPACITORS			
C1	1900µf, 50V, Alum Foil	811530018	48	39D198G050JS4
C2	3.3µf, 15V, 10%, Sol Ta	811501093	48	150D335X9015A2
C3	100pf, 500V, Sil Mica	811581008	74	DM15D101J
C4	6.8µf, 35V, 10%, Sol Ta	811501205	48	150D685X9035B2
C5	33µf, 10V, 10%, Sol Ta	811501067	48	150D336X9010B2
C6	100µf, 20V, 10%, Sol Ta	811501166	48	150D107X9020S2
C7	100µf, 20V, 10%, Sol Ta	811501166	48	150D107X9020S2
C8	1900µf, 50V, Alum Foil	811530018	48	39D198G050JS4
C9	3.3µf, 15V, 10%, Sol Ta	811501093	48	150D335X9015A2
C10	100pf, 500V, Sil Mica	811581008	79	DM15D101J
C11	6.8µf, 35V, 10%, Sol Ta	811501205	48	150D685X9035B2
C12	33µf, 10V, 10%, Sol Ta	811501067	48	150D336X9010B2
C13	100µf, 20V, 10%, Sol Ta	811501166	48	150D107X9020S2
C14	100µf, 20V, 10%, Sol Ta	811501166	48	150D107X9020S2
	DIODES			
CR1	RECT	818100007		IN4005
CR2	RECT	818100007		IN4005
CR3	RECT	818100007		IN4005
CR4	RECT	818100007		IN4005
CR5	RECT	818100007		IN4005
CR6	ZENER, 6.2V	818175002		IN823A
CR7	RECT	818100007		IN4005
CR8	RECT	818100007		IN4005
CR9	RECT	818100007		IN4005
CR10	RECT	818100007		IN4005

MODEL P11 ASSEMBLY D41566 G1 (continued)

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	MANUFACTURER CODE	MANUFACTURER PART NUMBER
A1	-15/+15V REGULATOR CARD ASM (continued)			
	DIODES (continued)			
CR11	RECT	818100007		IN4005
CR12	RECT	818100007		IN4005
CR13	ZENER 6.2V	818175002		IN823A
CR14	RECT	818100007		IN4005
CR15	RECT	818100007		IN4005
CR16	RECT	818100007		IN4005
CR17	RECT	818100007		IN4005
	TRANSISTORS			
Q1	PNP	818203906		2N3906
Q2	NPN	818203904		2N3904
Q3	FET	818204093		2N4093
Q4	NPN	818203904		2N3904
Q5	PNP	818203906		2N3906
Q6	PNP	818205464		2N5464
	RESISTORS			
R1	1.5k, 1/4W, 5%, Fxd Comp	817007152		RC07
R2	10k, 1/4W, 5%, Fxd Comp	817007103		RC07
R3	150k, 1/4W, 5%, Fxd Comp	817007154		RC07
R4	1k, 1/4W, 5%, Fxd Comp	817007102		RC07
R5	10k, 1/4W, 5%, Fxd Comp	817007103		RC07
R6	4.7k, 1/4W, 5%, Fxd Comp	817007472		RC07
R7	910 ohm, 1/4W, 5%, Fxd Comp	817007911		RC07
R8	1.18k, 1/8W, 1%, Metflm	817211118		RN60D
R9	9.09k, 1/8W, 1%, Metflm	817211909		RN60D
R10	2.2k, 1/4W, 5%, Fxd Comp	817117222		RC07
R11	Pot, 1k	817801019	29	66WR1K
R12	6.19k, 1/8W, 1%, Metflm	817211619		RN60D
R13	1.5k, 1/4W, 5%, Fxd Comp	817007152		RC07
R14	10k, 1/4W, 5%, Fxd Comp	817007103		RC07
R15	150k, 1/4W, 5%, Fxd Comp	817007154		RC07

REPERENCE DESIGNATION	DESCRIPTION	ITHACO PART NUMBER	MANUFACTURER CODE	MANUFACTURER PART NUMBER
A1	-15/+15V Regulator Card Asm (cont)			
	RESISTORS (continued)			
R16	1k, 1/4W, 5%, Fxd Comp	817007102		RC07
R17	10k, 1/4W, 5%, Fxd Comp	817007103		RC07
R18	4.7k, 1/4W, 5%, Fxd Comp	817007472		RC07
R19	910 ohm, 1/4W, 5%, Fxd Comp	817007911		RC07
R20	1.18k, 1/8W, 1%, Metflm	817211118		RN60D
R21	9.09k, 1/8W, 1%, Metflm	817211909		RN60D
R22	2.2k, 1/4W, 5%, Fxd Comp	817007222		RC07
R23	Pot, 1K	817801019	29	66WR1K
R24	6.19k, /8W, 1%, Metflm	817211619		RN60D
R25	15k, 1/4W, 5%, Fxd Comp	817007153		RC07
R26	100k, 1/4W, 5%, Fxd Comp	817007104		RC07
F1	Fuse, 1 1/2A Fast Acting	815183013	9	AGC
P1	Connector, 16 Pin	812122003	4	26-4100-16P
Q1	Transistor, Power	818700017		MJE-1092
	RESISTORS			
R1	0.8 ohm, 7.5W, 5%, WW	817002014	43	RCL-A65
R2	0.8 ohm, 7.5W, 5%, WW	817002014	43	RCL-AL5
R3	27k, 1/4W, 5%, Fxd Comp	817007273		RC07
S1-DS1	Switch, Neon-Lighted	815160007	34	616-6-1-A1H
T1	Transformer	B88100P1	31	B88100P1
XA2	Connector, 10 Pin	812127004	94	C-404-010

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	MANUFACTURER CODE	MANUFACTURER PART NUMBER
	BASIC ASSEMBLY	D41565G1		
A1	-15/+15V REGULATOR CARD ASM	C31386G1		
AR1	Op Amp LM301A	A86050P4	31	A86050P4
AR2	Op Amp LM301A	A86050P4	31	A86050P4
	CAPACITORS			
C1	1900µf, 50V, Alum Foil	811530018	48	39D198G050JS4
C2	3.3µf, 15V, 10%, Sol Ta	811501093	48	150D335X9015A2
C3	100pf, 500V, Sil Mica	811581008	74	DM15D101J
C4	6.8µf, 35V, 10%, Sol Ta	811501205	48	150D685X9035B2
C5	33µf, 10V, 10%, Sol Ta	811501067	48	150D336X9010B2
C6	100µf, 20V, 10%, Sol Ta	811501166	48	150D107X9020S2
C7	100µf, 20V, 10%, Sol Ta	811501166	48	150D107X9020S2
C8	1900µf, 50V, Alum Foil	811530018	48	39D198G050JS4
C9	3.3µf, 15V, 10%, Sol Ta	811501093	48	150D335X9015A2
C10	100pf, 500V, Sil Mica	811581008	79	DM15D101J
C11	6.8µf, 35V, 10%, Sol Ta	811501205	48	150D685X9035B2
C12	33µf, 10V, 10%, Sol Ta	811501067	48	150D336X9010B2
C13	100µf, 20V, 10%, Sol Ta	811501166	48	150D107X9020S2
C14	100µf, 20V, 10%, Sol Ta	811501166	48	150D107X9020S2
	DIODES			
CR1	RECT	818100007		IN4005
CR2	RECT	818100007		IN4005
CR3	RECT	818100007		IN4005
CR4	RECT	818100007		IN4005
CR5	RECT	818100007		IN4005
CR6	ZENER, 6.2V	818175002		IN823A
CR7	RECT	818100007		IN4005
CR8	RECT	818100007		IN4005
CR9	RECT	818100007		IN4005
CR10	RECT	818100007		IN4005

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	MANUFACTURER CODE	MANUFACTURER PART NUMBER
A1	-15/+15V Regulator Card Asm(cont)			
	DIODES (continued)			
CR11	RECT	818100007		IN4005
CR12	RECT	818100007		IN4005
CR13	ZENER 6.2V	818175002		IN823A
CR14	RECT	818100007		IN4005
CR15	RECT	818100007		IN4005
CR16	RECT	818100007		IN4005
CR17	RECT	818100007		IN4005
	TRANSISTORS			
Q1	PNP	818203906		2N3906
Q2	NPN	818203904		2N3904
Q3	FET	818204093		2N4093
Q4	NPN	818203904		2N3904
Q5	PNP	818203906		2N3906
Q6	PNP	818205464		2N5464
	RESISTORS			
R1	1.5k, 1/4W, 5%, Fxd Comp	817007152		RC07
R2	10k, 1/4W, 5%, Fxd Comp	817007103		RC07
R3	150k, 1/4W, 5%, Fxd Comp	817007154		RC07
R4	1k, 1/4W, 5%, Fxd Comp	817007102		RC07
R5	10k, 1/4W, 5%, Fxd Comp	817007103		RC07
R6	4.7k, 1/4W, 5%, Fxd Comp	817007472		RC07
R7	910 ohm, 1/4W, 5%, Fxd Comp	817007911		RC07
R8	1.18k, 1/8W, 1%, Metflm	817211118		RN60D
R9	9.09k, 1/8W, 1%, Metflm	817211909		RN60D
R10	2.2k, 1/4W, 5%, Fxd Comp	817117222		RC07
R11	Pot, 1k	817801019	29	66WR1K
R12	6.19k, 1/8W, 1%, Metflm	817211619		RN60D
R13	1.5k, 1/4W, 5%, Fxd Comp	817007152		RC07
R14	10k, 1/4W, 5%, Fxd Comp	817007103		RC07
R15	150k, 1/4W, 5%, Fxd Comp	817007154		RC07

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	MANUFACTURER CODE	MANUFACTURER PART NUMBER
A1	-15/+15V Regulator Card Asm (cont)			
	RESISTORS (continued)			
R16	1k, 1/4W, 5%, Fxd Comp	817007102		RC07
R17	10k, 1/4W, 5%, Fxd Comp	817007103		RC07
R18	4.7k, 1/4W, 5%, Fxd Comp	817007472		RC07
R19	910 ohm, 1/4W, 5%, Fxd Comp	817007911		RC07
R20	1.18k, 1/8W, 1%, Metflm	817211118		RN60D
R21	9.09k, 1/8W, 1%, Metflm	817211909		RN60D
R22	2.2k, 1/4W, 5%, Fxd Comp	817007222		RC07
R23	Pot, 1k	817801019		66WR1K
R24	6.19k, 1/8W, 1%, Metflm	817211619		RN60D
R25	15k, 1/4W, 5%, Fxd Comp	817007153		RC07
R26	100k, 1/4W, 5%, Fxd Comp	817007104		RC07
A2	±28V REGULATOR CARD ASSEMBLY	C31387G1		
AR1	Op Amp LM301A	A86050P4	31	A86050P4
	CAPACITORS			
C1	350µf, 75V, Alum Foil	811530022	48	39D357G075GL4
C3	100pf, 500V, 5%, Sil Mica	811581008	79	DM15D101J
C4	6.8µf, 35V, 10%, Sol Ta	811501205	48	150D685X9035B2
C5	33µf, 10V, 10%, Sol Ta	811501067	48	150D336X9010B2
C6	47µf, 35V, 10%, Sol Ta	811501215	48	150D476X9035S2
C8	0.1µF, 100V, 20%, Cer	811570014	25	8131-100-651-104M
	DIODES			
CR1	RECT	818100007		IN4005
CR2	RECT	818100007		IN4005
CR3	RECT	818100007		IN4005
CR4	RECT	818100007		IN4005
CR5	RECT	818100007		IN4005
CR6	ZENER SZ6.5V	818150015	46	SZ6.5V
CR7	RECT	818100007		IN4005
CR8	RECT	818100007		IN4005
CR9	RECT	818100007		IN4005
CR10	RECT	818100007		IN4005
L1	Choke (Ferrite Bead)	811800014	51	1568

REPERENCE DESIGNATION	DESCRIPTION	ITHACO PART NUMBER	MANUFACTURER CODE	MANUFACTURER PART NUMBER
A2				
	TRANSISTORS			
Q1	PNP	818204920		2N4920
Q2	PNP	818700020		2N3251A
Q3	PNP	818700020		2N3251A
Q5	U1673	A86039P5	31	A86039P5
	RESISTORS			
R1	100 ohm, 1/4W, 5%, Fxd Comp	817007101		RC07
R2	100k, 1/4W, 5%, Fxd Comp	817007104		RC07
R3	1k, 1/4W, 5%, Fxd Comp	817007102		RC07
R4	1k, 1/4W, 5%, Fxd Comp	817007102		RC07
R7	150K, 1/4W, 5%, Fxt Comp	817007154		RC07
R9	4.7k, 1/4W, 5%, Fxt Comp	817007472		RC07
R10	5.6k, 1/4W, 5%, Fxt Comp	817007562		RC07
R11	3.9k, 1/4W, 5%, Fxt Comp--	817007392		RC07
R12	22.1k, 1/8W, 1%, Metflm	817212221		RN60D
R13	6.65k, 1/8W, 1%, Metflm	817211665		RN60D
R14	39 ohm, 1/4W, 5%, Fxt Comp	817007390		RC07
R15	2.2 ohm, 1 1/2W, 5%, WW	817002025	37	995-1A4038
R16	22 ohm, 1/4W, 5%, Fxt Comp	817007220		RC07
F1	Fuse, 1 1/2A Fast Acting	815183013	9	AGC
P1	Connector, 16 Pin	812122003	4	26-4100-16P
Q1	Transistor, Power	818700017		MJE1092
	RESISTORS			
R1	0.8 ohm, 7.5W, 5%, WW	817002014	43	RCL-AL5
R2	0.8 ohm, 7.5W, 5%, WW	817002014	43	RCL-AL5
R3	27k, 1/4W, 5%, Fxd Comp	817007273		RC07
S1-DS1	Switch, Neon-Lighted	815160007	34	616-61-1A1H
T1	Transformer	B88100P1	31	B88100P1
XA2	Connector, 10 Pin	812127004	94	C-404-010

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	MANUFACTURER CODE	MANUFACTURER PART NUMBER
	BASIC ASSEMBLY	D41565G1		
A1	-15/+15V REGULATOR CARD ASM	C31386G1		
AR1	Op Amp LM301A	A86050P4	31	A86050P4
AR2	Op Amp LM301A	A86050P4	31	A86050P4
	CAPACITORS			
C1	1900µf, 50V, Alum Foil	811530018	48	39D198G050JS4
C2	3.3µf, 15V, 10%, Sol Ta	811501093	48	150D335X9015A2
C3	100pf, 500V, Sil Mica	811581008	74	DM15D101J
C4	6.8µf, 35V, 10%, Sol Ta	811501205	48	150D685X9035B2
C5	33µf, 10V, 10%, Sol Ta	811501067	48	150D336X9010B2
C6	100µf, 20V, 10%, Sol Ta	811501166	48	150D107X9020S2
C7	100µf, 20V, 10%, Sol Ta	811501166	48	150D107X9020S2
C8	1900µf, 50V, Alum Foil	811530018	48	39D198G050JS4
C9	3.3µf, 15V, 10%, Sol Ta	811501093	48	150D335X9015A2
C10	100pf, 500V, Sil Mica	811581008	79	DM15D101J
C11	6.8µf, 35V, 10%, Sol Ta	811501205	48	150D685X9035B2
C12	33µf, 10V, 10%, Sol Ta	811501067	48	150D336X9010B2
C13	100µf, 20V, 10%, Sol Ta	811501166	48	150D107X9020S2
C14	100µf, 20V, 10%, Sol Ta	811501166	48	150D107X9020S2
	DIODES			
CR1	RECT	818100007		IN4005
CR2	RECT	818100007		IN4005
CR3	RECT	818100007		IN4005
CR4	RECT	818100007		IN4005
CR5	RECT	818100007		IN4005
CR6	ZENER, 6.2V	818175002		IN823A
CR7	RECT	818100007		IN4005
CR8	RECT	818100007		IN4005
CR9	RECT	818100007		IN4005
CR10	RECT	818100007		IN4005

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	MANUFACTURER CODE	MANUFACTURER PART NUMBER
A1	-15/+15 Regulator Card Asm (cont)			
	DIODES (continued)			
CR11	RECT	818100007		IN4005
CR12	RECT	818100007		IN4005
CR13	ZENER 6.2V	818175002		IN823A
CR14	RECT	818100007		IN4005
CR15	RECT	818100007		IN4005
CR16	RECT	818100007		IN4005
CR17	RECT	818100007		IN4005
	TRANSISTORS			
Q1	PNP	818203906		2N3906
Q2	NPN	818203904		2N3904
Q3	FET	818204093		2N4093
Q4	NPN	818203904		2N3904
Q5	PNP	818203906		2N3906
Q6	PNP	818205464		2N5464
	RESISTORS			
R1	1.5k, 1/4W, 5%, Fxd Comp	817007152		RC07
R2	10k, 1/4W, 5%, Fxd Comp	817007103		RC07
R3	150k, 1/4W, 5%, Fxd Comp	817007154		RC07
R4	1k, 1/4W, 5%, Fxd Comp	817007102		RC07
R5	10k, 1/4W, 5%, Fxd Comp	817007103		RC07
R6	4.7k, 1/4W, 5%, Fxd Comp	817007472		RC07
R7	910 ohm, 1/4W, 5%, Fxd Comp	817007911		RC07
R8	1.18k, 1/8W, 1%, Metflm	817211118		RN60D
R9	9.09k, 1/8W, 1%, Metflm	817211909		RN60D
R10	2.2k, 1/4W, 5%, Fxd Comp	817117222		RC07
R11	Pot, 1k	817801019	29	66WR1K
R12	6.19k, 1/8W, 1%, Metflm	817211619		RN60D
R13	1.5k, 1/4W, 5%, Fxd Comp	817007152		RC07
R14	10k, 1/4W, 5%, Fxd Comp	817007103		RC07
R15	150k, 1/4W, 5%, Fxd Comp	817007154		RC07

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	MANUFACTURER CODE	MANUFACTURER PART NUMBER
A1	-15/+15V Regulator Card Asm (cont)			
	RESISTORS (cont)			
R16	1k, 1/4W, 5%, Fxd Comp	817007102		RC07
R17	10k, 1/4W, 5%, Fxd Comp	817007103		RC07
R18	4.7k, 1/4W, 5%, Fxd Comp	817007472		RC07
R19	910 ohm, 1/4W, 5%, Fxd Comp	817007911		RC07
R20	1.18k, 1/8W, 1%, Metflm	817211118		RN60D
R21	9.09k, 1/8W, 1%, Metflm	817211909		RN60D
R22	2.2k, 1/4W, 5%, Fxd Comp	817007222		RC07
R23	Pot, 1k	817801019	29	66WR1K
R24	6.19k, 1/8W, 1%, Metflm	817211619		RN60D
R25	15k, 1/4W, 5%, Fxd Comp	817117153		RC07
R26	100k, 1/4W, 5%, Fxd Comp	817007104		RC07
A2	±28V REGULATOR CARD ASSEMBLY	C31387G1		
AR1	Op Amp LM301A	A86050P4	31	A86050P4
	CAPACITORS			
C1	350µf, 75V, Alum Foil	811530022	48	39D357G075GL4
C3	100pf, 500V, 5%, Sil Mica	811581008	79	DM15D101J
C4	6.8µf, 35V, 10%, Sol Ta	811501205	48	150D685X9035B2
C5	33µf, 10V, 10%, Sol Ta	811501067	48	150D336X9010B2
C6	47µf, 35V, 10%, Sol Ta	811501215	48	150D476X9035S2
C8	0.1µF, 100V, 20%, Cer	811570014	25	8131-100-651-104N
	DIODES			
CR1	RECT	818100007		IN4005
CR2	RECT	818100007		IN4005
CR3	RECT	818100007		IN4005
CR4	RECT	818100007		IN4005
CR5	RECT	818100007		IN4005
CR6	ZENER SZ6.5V	818150015	46	SZ6.5V
CR7	RECT	818100007		IN4005
CR8	RECT	818100007		IN4005
CR9	RECT	818100007		IN4005
CR10	RECT	818100007		IN4005
L1	Choke, Ferrite Bead	811800014	51	1568

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	MANUFACTURER CODE	MANUFACTURER PART NUMBER
A2	±28V Regulator Card Asm (cont)			
	TRANSISTORS			
Q1	PNP	818204920		2N4920
Q2	PNP	818700020		2N3251A
Q3	PNP	818700020		2N3251A
Q5	U1673	A86039P5	31	A86039P5
	RESISTORS			
R1	100 ohm, 1/4W, 5%, Fxd Comp	817007101		RC07
R2	100k, 1/4W, 5%, Fxd Comp	817007104		RC07
R3	1k, 1/4W, 5%, Fxd Comp	817007102		RC07
R4	1k, 1/4W, 5%, Fxd Comp	817007102		RC07
R7	150k, 1/4W, 5%, Fxt Comp	817007154		RC07
R9	4.7k, 1/4W, 5%, Fxt Comp	817007472		RC07
R10	5.6k, 1/4W, 5%, Fxt Comp	817007562		RC07
R11	3.9k, 1/4W, 5%, Fxt Comp	817007392		RC07
R12	22.1k, 1/8W, 1%, Metflm	817212221		RN60D
R13	6.65k, 1/8W, 1%, Metflm	817211665		RN60D
R14	39 ohm, 1/4W, 5%, Fxt Comp	817007390		RC07
R15	2.2 ohm, 1 1/2W, 5%, WW	817002025	37	995-1A4038
R16	22 ohm, 1/4W, 5%, Fxt Comp	817007220		RC07
A3	CAL OSCILLATOR CARD ASSEMBLY	C31855G1		
AR1	Op Amp LM301A	A86050P4	31	A86050P4
AR2	Op Amp LM301A	A86050P4	31	A86050P4
AR3	Op Amp AD741	816400019	5	AD741
AR4	Op Amp MC1438R	816400014	35	MC1438R
	CAPACITORS			
C1	.001µf, 500V, 1%, Sil Mica	811581049	79	DM15D102F
C2	.001µf, 500V, 1%, Sil Mica	811581049	79	DM15D102F
C3	.001µf, 500V, 1%, Sil Mica	811581049	79	DM15D102F
C4	33pf, 500V, Sil Mica	811581037	79	DM15D330J
C5	.001µf, 500V, 1%, Sil Mica	811581049	79	DM15D102F

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	MANUFACTURER CODE	MANUFACTURER PART NUMBER
A3	CAL OSCILLATOR CARD ASM (cont)			
	CAPACITORS (continued)			
C6	33pf, 500V, Sil Mica	811581037	79	DM15D330J
C8	.01µf, 500V, 20%, Cer	811570019	48	5GAS-S10
C9	.01µf, 500V, 20%, Cer	811570019	48	5GAS-S10
C10	470pf, 500V, Sil Mica	811581014	79	DM15D471J
CR1	IN823A, 6.2V Diode	818175002		IN823A
CR2	IN823A, 6.2V Diode	818175002		IN823A
	RESISTORS			
R1	113k, 1/8W, 1%, Metflm	817213113		RN60D
R2	113k, 1/8W, 1%, Metflm	817213113		RN60D
R3	110k, 1/8W, 1%, Metflm	817213110		RN60D
R4	110k, 1/8W, 1%, Metflm	817213110		RN60D
R5	511 ohm, 1/8W, 1%, Metflm	817210511		RN60D
R6	34.8k, 1/8W, 1%, Metflm	817212348		RN60D
R7	Pot, 50k	817806503	7	3299X-1-503
R8	1M, 1/4W, 5%, Fxd Comp	817007105		RC07
R9	1k, 1/4W, 5%, Fxd Comp	817007102		RC07
R10	3.9 ohm, 1/4W, 5%, Fxd Comp	817007399		RC07
R11	3.9 ohm, 1/4W, 5%, Fxd Comp	807007399		RC07
R12	1k, 1/4W, 5%, Fxd Comp	817007102		RC07
R13	10.0k, 1/8W, 0.1%, Metflm	817261048	42	PME55
R14	100 ohm, 1/8W, 0.1%, Metflm	817261032	42	PME55
S1	Switch, Rotary 3P 3 pos N-S	A88390P1	31	A88390P1
S2	Switch, Toggle DPDT	815111007	14	7201
F1	Fuse, 1 1/2A, Fast Acting	816183013	9	AGC
J1	Connector, BNC	812130110	19	30355-1
P1	Connector, 16 Pin	812122003	4	26-4100-16P
Q1	Transistor, Power	818700017		MJE1092

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	MANUFACTURER CODE	MANUFACTURER PART NUMBER
R1	0.8 ohm, 7.5W, 5%, WW	817002014	43	RCL-AL5
R2	0.8 ohm, 7.5W, 5%, WW	817002014	43	RCL-AL5
R3	27k, 1/4W, 5%, Fxd Comp	817007273		RC07
S1-DS1	Switch, Neon-Lighted	815160007	34	616-6-1-A1H
T1	Transformer	B88100P1	31	B88100P1
XA2	Connector, 10 Pin	812127004	94	C-404-010

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	MANUFACTURER CODE	MANUFACTURER PART NUMBER
	BASIC ASSEMBLY	D41565G1		
A1	-15/+15V REGULATOR CARD ASM	C31386G1		
AR1	Op Amp LM301A	A86050P4	31	A86050P4
AR2	Op Amp LM301A	A86050P4	31	A86050P4
	CAPACITORS			
C1	1900µf, 50V, Alum Foil	811530018	48	39D198G050JS4
C2	3.3µf, 15V, 10%, Sol Ta	811501093	48	150D335X9015A2
C3	100pf, 500V, Sil Mica	811581008	74	DM15D101J
C4	6.8µf, 35V, 10%, Sol Ta	811501205	48	150D685X9035B2
C5	33µf, 10V, 10%, Sol Ta	811501067	48	150D336X9010B2
C6	100µf, 20V, 10%, Sol Ta	811501166	48	150D107X9020S2
C7	100µf, 20V, 10%, Sol Ta	811501166	48	150D107X9020S2
C8	1900µf, 50V, Alum Foil	811530018	48	39D198G050JS4
C9	3.3µf, 15V, 10%, Sol Ta	811501093	48	150D335X9015A2
C10	100pf, 500V, Sil Mica	811581008	79	DM15D101J
C11	6.8µf, 35V, 10%, Sol Ta	811501205	48	150D685X9035B2
C12	33µf, 10V, 10%, Sol Ta	811501067	48	150D336X9010B2
C13	100µf, 20V, 10%, Sol Ta	811501166	48	150D107X9020S2
C14	100µf, 20V, 10%, Sol Ta	811501166	48	150D107X9020S2
	DIODES			
CR1	RECT	818100007		IN4005
CR2	RECT	818100007		IN4005
CR3	RECT	818100007		IN4005
CR4	RECT	818100007		IN4005
CR5	RECT	818100007		IN4005
CR6	ZENER, 6.2V	818175002		IN823A
CR7	RECT	818100007		IN4005
CR8	RECT	818100007		IN4005
CR9	RECT	818100007		IN4005
CR10	RECT	818100007		IN4005

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	MANUFACTURER CODE	MANUFACTURER PART NUMBER
A1	-15/+15V Regulator Card Asm (cont)			
	DIODES (continued)			
CR11	RECT	818100007		IN4005
CR12	RECT	818100007		IN4005
CR13	ZENER 6.2V	818175002		IN823A
CR14	RECT	818100007		IN4005
CR15	RECT	818100007		IN4005
CR16	RECT	818100007		IN4005
CR17	RECT	818100007		IN4005
	TRANSISTORS			
Q1	PNP	818203906		2N2906
Q2	NPN	818203904		2N3904
Q3	FET	818204093		2N4093
Q4	NPN	818203904		2N3904
Q5	PNP	818203906		2N3906
Q6	PNP	818205464		2N5464
	RESISTORS			
R1	1.5k, 1/4W, 5%, Fxd Comp	817007152		RC07
R2	10k, 1/4W, 5%, Fxd Comp	817007103		RC07
R3	150k, 1/4W, 5%, Fxd Comp	817007154		RC07
R4	1k, 1/4W, 5%, Fxd Comp	817007102		RC07
R5	10k, 1/4W, 5%, Fxd Comp	817007103		RC07
R6	4.7k, 1/4W, 5%, Fxd Comp	817007472		RC07
R7	910 ohm, 1/4W, 5%, Fxd Comp	817007911		RC07
R8	1.18k, 1/8W, 1%, Metflm	817211118		RN60D
R9	9.09k, 1/8W, 1%, Metflm	817211909		RN60D
R10	2.2k, 1/4W, 5%, Fxd Comp	817117222		RC07
R11	Pot, 1k	817801019	29	66WR1K
R12	6.19k, 1/8W, 1%, Metflm	817211619		RN60D
R13	1.5k, 1/4W, 5%, Fxd Comp	817007152		RC07
R14	10k, 1/4W, 5%, Fxd Comp	817007103		RC07
R15	150k, 1/4W, 5%, Fxd Comp	817007154		RC07

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	MANUFACTURER CODE	MANUFACTURER PART NUMBER
A1	-15/+15V Regulator Card Asm(cont)			
	RESISTORS (cont)			
R16	1k, 1/4W, 5%, Fxd Comp	817007102		RC07
R17	10k, 1/4W, 5%, Fxd Comp	817007103		RC07
R18	4.7k, 1/4W, 5%, Fxd Comp	817007472		RC07
R19	910 ohm, 1/4W, 5%, Fxd Comp	817007911		RC07
R20	1.18k, 1/8W, 1%, Metflm	817211118		RN60D
R21	9.09k, 1/8W, 1%, Metflm	817211909		RN60D
R22	2.2k, 1/4W, 5%, Fxd Comp	817007222		RC07
R23	Pot, 1k	817801019	29	66WR1K
R24	6.19k, 1/8W, 1%, Metflm	817211619		RN60D
R25	15k, 1/4W, 5%, Fxd Comp	817007104		RC07
R26	100k, 1/4W, 5%, Fxd Comp	817007104		RC07
A2	-55V REGULATOR CARD ASSEMBLY	C31388G1		
AR1	Op Amp LM301A	A86050P4	31	A86050P4
	CAPACITORS			
C1	350µf, 75V, Alum Foil	811530022	48	39D357G075GL4
C2	350µf, 75V, Alum Foil	811530022	48	39D357G075GL4
C3	100pf, 500V, 5%, Sil Mica	811581008	79	DM15D101J
C4	22µf, 100V, 20%, Sol Ta	811500006	48	109D226X1000F2
C5	22µf, 100V, 20%, Sol Ta	811500006	48	109D226X1000F2
C6	3.3µf, 15V, 10%, Sol Ta	811501093	48	150D335X9015A2
	DIODES			
CR1	RECT	818100007		IN4005
CR2	RECT	818100007		IN4005
CR3	RECT	818100007		IN4005
CR4	SI	818100003		IN4148
CR5	RECT	818100007		IN4005
CR6	RECT	818100007		IN4005
CR7	RECT	818100007		IN4005
CR8	RECT	818100007		IN4005

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	MANUFACTURER CODE	MANUFACTURER PART NUMBER
A2	-55V REGULATOR CARD ASM (cont)	C31388G1		
	TRANSISTORS			
Q1	NPN	818700019		MPSU03
Q2	PNP	818205401		2N5401
Q3	PNP	818203906		2N3906
Q4	NPN	818203904		2N3904
	RESISTORS			
R1	1k, 1/4W, 5%, Fxd Comp	817007102		RC07
R2	3.9k, 1/2W, 5%, Fxd Comp	817020392		RC20
R3	1k, 1/4W, 5%, Fxd Comp	817007102		RC07
R4	9.09k, 1/8W, 1%, Metflm	817211909		RN60D
R5	1k, 1/4W, 5%, Fxd Comp	817007102		RC07
R6	56k, 1/4W, 5%, Fxd Comp	817007563		RC07
R7	2.7k, 1/4W, 5%, Fxd Comp	817007272		RC07
R8	9.1 ohm, 1/4W, 5%, Fxd Comp	817007919		RC07
R9	10.0k, 1/8W, 1%, Metflm=	817212100		RN60D
R10	15k, 1/4W, 5%, Fxd Comp	817007153		RC07
R11	56.2k, 1/8W, 1%, Metflm	817212562		RN60D
R12	10.0k, 1/8W, 1%, Metflm	817212100		RN60D
R13	5.11k, 1/8W, 1%, Metflm	817211511		RN60D
F1	Fuse, 1 1/2A Fast Acting	815183013	9	AGC
P1	Connector, 16 Pin	812122003	4	26-4100-16P
Q1	Transistor, Power	818600017		MJE1092
	RESISTORS			
R1	0.8 ohm, 7.5W, 5%, WW	817002014	43	RCL-AL5
R2	0.8 ohm, 7.5W, 5%, WW	817002014	43	RCL-AL5
R3	27k, 1/4W, 5%, Fxd Comp	817007273		RC07
S1-DS1	Switch, Neon Lighted	815160007	34	616-6-1-A1H
T1	Transformer	B88100P1	31	B88100P1
XA2	Connector, 10 Pin	812127004	94	C-404-010

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	MANUFACTURER CODE	MANUFACTURER PART NUMBER
	BASIC ASSEMBLY	D41565G1		
A1	-15/+15V REGULATOR CARD ASM	C31386G1		
AR1	Op Amp LM301A	A86050P4	31	A86050P4
AR2	Op Amp LM301A	A86050P4	31	A86050P4
	CAPACITORS			
C1	1900µf, 50V, Alum Foil	811530018	48	39D198G050JS4
C2	3.3µf, 15V, 10%, Sol Ta	811501093	48	150D335X9015A2
C3	100pf, 500V, Sil Mica	811581008	74	DM15D101J
C4	6.8µf, 35V, 10%, Sol Ta	811501205	48	150D685X9035B2
C5	33µf, 10V, 10%, Sol Ta	811501067	48	150D336X9010B2
C6	100µf, 20V, 10%, Sol Ta	811501166	48	150D107X9020S2
C7	100µf, 20V, 10%, Sol Ta	811501166	48	150D107X9020S2
C8	1900µf, 50V, Alum Foil	811530018	48	39D198G050JS4
C9	3.3µf, 15V, 10%, Sol Ta	811501093	48	150D335X9015A2
C10	100pf, 500V, Sil Mica	811581008	79	DM15D101J
C11	6.8µf, 35V, 10%, Sol Ta	811501205	48	150D685X9035B2
C12	33µf, 10V, 10%, Sol Ta	811501067	48	150D336X9010B2
C13	100µf, 20V, 10%, Sol Ta	811501166	48	150D107X9020S2
C14	100µf, 20V, 10%, Sol Ta	811501166	48	150D107X9020S2
	DIODES			
CR1	RECT	818100007		IN4005
CR2	RECT	818100007		IN4005
CR3	RECT	818100007		IN4005
CR4	RECT	818100007		IN4005
CR5	RECT	818100007		IN4005
CR6	ZENER, 6.2V	818175002		IN823A
CR7	RECT	818100007		IN4005
CR8	RECT	818100007		IN4005
CR9	RECT	818100007		IN4005
CR10	RECT	818100007		IN4005

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	MANUFACTURER CODE	MANUFACTURER PART NUMBER
A1	-15/+15V REGULATOR CARD (cont)			
	DIODES (continued)			
CR11	RECT	818100007		IN4005
CR12	RECT	818100007		IN4005
CR13	ZENER 6.2V	818175002		IN823A
CR14	RECT	818100007		IN4005
CR15	RECT	818100007		IN4005
CR16	RECT	818100007		IN4005
CR17	RECT	818100007		IN4005
	TRANSISTORS			
Q1	PNP	818203906		2N3906
Q2	NPN	818203904		2N3904
Q3	FET	818204093		2N4093
Q4	NPN	818203904		2N3904
Q5	PNP	818203906		2N3906
Q6	PNP	818205464		2N5464
	RESISTORS			
R1	1.5k, 1/4W, 5%, Fxd Comp	817007152		RC07
R2	10k, 1/4W, 5%, Fxd Comp	817007103		RC07
R3	150k, 1/4W, 5%, Fxd Comp	817007154		RC07
R4	1k, 1/4W, 5%, Fxd Comp	817007102		RC07
R5	10k, 1/4W, 5%, Fxd Comp	817007103		RC07
R6	4.7k, 1/4W, 5%, Fxd Comp	817007472		RC07
R7	910 ohm, 1/4W, 5%, Fxd Comp	817007911		RC07
R8	1.18k, 1/8W, 1%, Metflm	817211118		RN60D
R9	9.09k, 1/8W, 1%, Metflm	817211909		RN60D
R10	2.2k, 1/4W, 5%, Fxd Comp	817117222		RC07
R11	Pot, 1k	817801019	29	66WR1K
R12	6.19k, 1/8W, 1%, Metflm	817211619		RN60D
R13	1.5k, 1/4W, 5%, Fxd Comp	817007152		RC07
R14	10k, 1/4W, 5%, Fxd Comp	817007103		RC07
R15	150k, 1/4W, 5%, Fxd Comp	817007154		RC07

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	MANUFACTURER CODE	MANUFACTURER PART NUMBER
A1	-15/+15V REGULATOR CARD (cont)			
	RESISTORS (continued)			
R16	1k, 1/4W, 5%, Fxd Comp	817007102		RC07
R17	10k, 1/4W, 5%, Fxd Comp	817007103		RC07
R18	4.7k, 1/4W, 5%, Fxd Comp	817007472		RC07
R19	910 ohm, 1/4W, 5%, Fxd Comp	817007911		RC07
R20	1.18k, 1/8W, 1%, Metflm	817211118		RN60D
R21	9.09k, 1/8W, 1%, Metflm	817211909		RN60D
R22	2.2k, 1/4W, 5%, Fxd Comp	817007222		RC07
R23	Pot, 1k	817801019	29	66WR1K
R24	6.19k, 1/8W, 1%, Metflm	817211619		RN60D
R25	15k, 1/4W, 5%, Fxd Comp	817007153		RC07
R26	100k, 1/4W, 5%, Fxd Comp	817007104		RC07
A2	±28V REGULATOR CARD ASSEMBLY	C31387G1		
AR1	Op Amp LM301A	A86050P4	31	A86050P4
	CAPACITORS			
C1	350µf, 75V, Alum Foil	811530022	48	39D357G075GL4
C3	100pf, 500V, 5%, Sil Mica	811581008	79	DM15D101J
C4	6.8µf, 35V, 10%, Sol Ta	811501205	48	150D685X9035B2
C5	33µf, 10V, 10%, Sol Ta	811501067	48	150D336X9010B2
C6	47µf, 35V, 10%, Sol Ta	811501215	48	150D476X9035S2
C8	0.1µF, 100V, 20%, Cer	811570014	25	8131-1001651-104
	DIODES			
CR1	RECT	818100007		IN4005
CR2	RECT	818100007		IN4005
CR3	RECT	818100007		IN4005
CR4	RECT	818100007		IN4005
CR5	RECT	818100007		IN4005
CR6	ZENER SZ6.5V	818100015	46	SZ6.5V
CR7	RECT	818100007		IN4005
CR8	RECT	818100007		IN4005
CR9	RECT	818100007		IN4005
CR10	RECT	818100007		IN4005
L1	Choke (Ferrite Bead)	811800014	51	1568

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	MANUFACTURER CODE	MANUFACTURER PART NUMBER
A2	±28V REGULATOR CARD ASM (cont)			
	TRANSISTORS			
Q1	PNP	818204920		2N4920
Q2	PNP	818700020		2N3251A
Q3	PNP	818700020		2N3251A
Q5	U1673	A86039P5	31	A86039P5
	RESISTORS			
R1	100 ohm, 1/4W, 5%, Fxd Comp	817007101		RC07
R2	100k, 1/4W, 5%, Fxd Comp	817007104		RC07
R3	1k, 1/4W, 5%, Fxd Comp	817007102		RC07
R4	1k, 1/4W, 5%, Fxd Comp	817007102		RC07
R7	150k, 1/4W, 5%, Fxt Comp	817007154		RC07
R9	4.7k, 1/4W, 5%, Fxt Comp	817007472		RC07
R10	5.6k, 1/4W, 5%, Fxt Comp	817007562		RC07
R11	3.9k, 1/4W, 5%, Fxt Comp	817007392		RC07
R12	22.1k, 1/8W, 1%, Metflm	817212221		RN60D
R13	6.65k, 1/8W, 1%, Metflm	817211665		RN60D
R14	39 ohm, 1/4W, 5%, Fxt Comp	817007390		RC07
R15	2.2 ohm, 1 1/2W, 5%, WW	817002025	37	995-1A4038
R16	22 ohm, 1/4W, 5%, Fxt Comp	817007220		RC07
A3	CAL OSCILLATOR CARD ASSEMBLY	C31855G1		
AR1	Op Amp LM301A	A86050P4	31	A86050P4
AR2	Op Amp LM301A	A86050P4	31	A86050P4
AR3	Op Amp AD741	816400019	5	AD741
AR4	Op Amp MC1438R	816400014	35	MC1438R
	CAPACITORS			
C1	.001µf, 500V, 1%, Sil Mica	811581049	79	DM15D102F
C2	.001µf, 500V, 1%, Sil Mica	811581049	79	DM15D102F
C3	.001µf, 500V, 1%, Sil Mica	811581049	79	DM15D102F
C4	33pf, 500V, Sil Mica	811581037	79	DM15D330J
C5	.001µf, 500V, 1%, Sil Mica	811581049	79	DM15D102F

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	MANUFACTURER CODE	MANUFACTURER PART NUMBER
A3	CAL OSCILLATOR CARD ASM (cont)			
	CAPACITORS (continued)			
C6	33pf, 500V, Sil Mica	811581037	79	DM15D330J
C8	.01µf, 500V, 20%, Cer	811570019	48	5GAS-S10
C9	.01µf, 500V, 20%, Cer	811570019	48	5GAS-S10
C10	470pf, 500V, Sil Mica	811581014	79	DM15D471J
CR1	IN823A, 6.2V Diode	818175002		IN823A
CR2	IN823A, 6.2V Diode	818175002		IN823A
	RESISTORS			
R1	113k, 1/8W, 1%, Metflm	817213113		RN60D
R2	113k, 1/8W, 1%, Metflm	817213113		RN60D
R3	110k, 1/8W, 1%, Metflm	817213110		RN60D
R4	110k, 1/8W, 1%, Metflm	817213110		RN60D
R5	511 ohm, 1/8W, 1%, Metflm	817210511		RN60D
R6	34.8k, 1/8W, 1%, Metflm	817212348		RN60D
R7	Pot, 50k	817806503	7	3299X-1-503
R8	1M, 1/4W, 5%, Fxd Comp	817007105		RC07
R9	1k, 1/4W, 5%, Fxd Comp	817007102		RC07
R10	3.9 ohm, 1/4W, 5%, Fxd Comp	817007399		RC07
R11	3.9 ohm, 1/4W, 5%, Fxd Comp	817007399		RC07
R12	1k, 1/4W, 5%, Fxd Comp	817007102		RC07
R13	10.0k, 1/8W, 0.1%, Metflm	817261048	42	PME55
R14	100 ohm, 1/8W, 0.1%, Metflm	817261032	42	PME55
S1	Switch, Rotary 3P 3 pos N-S	A88390P1	31	A88390P1
S2	Switch, Toggle DPDT	815111007	14	7201
F1	Fuse, 1 1/3A, Fast Acting	815183013	9	AGC
J1	Connector, BNC	812130110	19	30355-1
P1	Connector, 16 Pin	812122003	4	26-4100-16P
Q1	Transistor, Power	818700017		MJE1092

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	MANUFACTURER CODE	MANUFACTURER PART NUMBER
	RESISTORS			
R1	0.8 ohm, 7.5W, 5%, WW	817002014	43	RCL-AL5
R2	0.8 ohm, 7.5W, 5%, WW	817002014	43	RCL-AL5
R3	27k, 1/4W, 5%, Fxd Comp	817007273		RC07
S1-DS1	Switch, Neon-Lighted	815160007	34	616-6-1-A1H
T1	Transformer	B88100P1	31	B88100P1
XA2	Connector, 10 Pin	812127004	94	C-404-010

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	MANUFACTURER CODE	MANUFACTURER PART NUMBER
	BASIC ASSEMBLY	D41565G1		
A1	-15/+15V REGULATOR CARD ASM	C31386G1		
AR1	Op Amp LM301A	A86050P4	31	A86050P4
AR2	Op Amp LM301A	A86050P4	31	A86050P4
	CAPACITORS			
C1	1900µf, 50V, Alum Foil	811530018	48	39D198G050JS4
C2	3.3µf, 15V, 10%, Sol Ta	811501093	48	150D335X9015A2
C3	100pf, 500V, Sil Mica	811581008	74	DM15D101J
C4	6.8µf, 35V, 10%, Sol Ta	811501205	48	150D685X9035B2
C5	33µf, 10V, 10%, Sol Ta	811501067	48	150D336X9010B2
C6	100µf, 20V, 10%, Sol Ta	811501166	48	150D107X9020S2
C7	100µf, 20V, 10%, Sol Ta	811501166	48	150D107X9020S2
C8	1900µf, 50V, Alum Foil	811530018	48	39D198G050JS4
C9	3.3µf, 15V, 10%, Sol Ta	811501093	48	150D335X9015A2
C10	100pf, 500V, Sil Mica	811581008	79	DM15D101J
C11	6.8µf, 35V, 10%, Sol Ta	811501205	48	150D685X9035B2
C12	33µf, 10V, 10%, Sol Ta	811501067	48	150D336X9010B2
C13	100µf, 20V, 10%, Sol Ta	811501166	48	150D107X9020S2
C14	100µf, 20V, 10%, Sol Ta	811501166	48	150D107X9020S2
	DIODES			
CR1	RECT	818100007		IN4005
CR2	RECT	818100007		IN4005
CR3	RECT	818100007		IN4005
CR4	RECT	818100007		IN4005
CR5	RECT	818100007		IN4005
CR6	ZENER, 6.2V	818175002		IN823A
CR7	RECT	818100007		IN4005
CR8	RECT	818100007		IN4005
CR9	RECT	818100007		IN4005
CR10	RECT	818100007		IN4005

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	MANUFACTURER CODE	MANUFACTURER PART NUMBER
A1	-15/+15V Regulator Card Asm(cont)			
	DIODES (continued)			
CR11	RECT	818100007		IN4005
CR12	RECT	818100007		IN4005
CR13	ZENER 6.2V	818175002		IN823A
CR14	RECT	818100007		IN4005
CR15	RECT	818100007		IN4005
CR16	RECT	818100007		IN4005
CR17	RECT	818100007		IN4005
	TRANSISTORS			
Q1	PNP	818203906		2N3906
Q2	NPN	818203904		2N3904
Q3	FET	818204093		2N4093
Q4	NPN	818203904		2N3904
Q5	PNP	818203906		2N3906
Q6	PNP	818205464		2N5464
	RESISTORS			
R1	1.5k, 1/4W, 5%, Fxd Comp	817008152		RC07
R2	10k, 1/4W, 5%, Fxd Comp	817007103		RC07
R3	150k, 1/4W, 5%, Fxd Comp	817007154		RC07
R4	1k, 1/4W, 5%, Fxd Comp	817007102		RC07
R5	10k, 1/4W, 5%, Fxd Comp	817007103		RC07
R6	4.7k, 1/4W, 5%, Fxd Comp	817007472		RC07
R7	910 Ohm, 1/4W, 5%, Fxd Comp	817117911		RC07
R8	1.18k, 1/8W, 1%, Metflm	817211118		RN60D
R9	9.09k, 1/8W, 1%, Metflm	817211909		RN60D
R10	2.2k, 1/4W, 5%, Fxd Comp	817117222		RC07
R11	Pot, 1k	817801019	29	66WR1K
R12	6.19k, 1/8W, 1%, Metflm	817211619		RN60D
R13	1.5k, 1/4W, 5%, Fxd Comp	817007152		RC07
R14	10k, 1/4W, 5%, Fxd Comp	817007103		RC07
R15	150k, 1/4W, 5%, Fxd Comp	817007154		RC07

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	MANUFACTURER CODE	MANUFACTURER PART NUMBER
A1	-15/+15V Regulator Card Asm (cont)			
	RESISTORS (continued)			
R16	1k, 1/4W, 5%, Fxd Comp	817007102		RC07
R17	10k, 1/4W, 5%, Fxd Comp	817007103		RC07
R18	4.7k, 1/4W, 5%, Fxd Comp	817007472		RC07
R19	910 ohm, 1/4W, 5%, Fxd Comp	817007911		RC07
R20	1.18k, 1/8W, 1%, Metflm	817211118		RN60D
R21	9.09k, 1/8W, 1%, Metflm	817211909		RN60D
R22	2.2k, 1/4W, 5%, Fxd Comp	817007222		RC07
R23	Pot, 1k	817801019	29	66WR1K
R24	6.19k, 1/8W, 1%, Metflm	817211619		RN60D
R25	15k, 1/4W, 5%, Fxd Comp	817007153		RC07
R26	100k, 1/4W, 5%, Fxd Comp	817007104		RC07
A3	CAL OSCILLATOR CARD ASSEMBLY	C31855G1		
AR1	Op Amp LM301A	A86050P4	31	A86050P4
AR2	Op Amp LM301A	A86050P4	31	A86050P4
AR3	Op Amp AD741	816400019	5	AD741
AR4	Op Amp MC1438R	816400014	35	MC1438R
	CAPACITORS			
C1	.001µf, 500V, 1%, Sil Mica	811581049	79	DM15D102F
C2	.001µf, 500V, 1%, Sil Mica	811581049	79	DM15D102F
C3	.001µf, 500V, 1%, Sil Mica	811581049	79	DM15D102F
C4	33pf, 500V, Sil Mica	811581037	79	DM15D330J
C5	.001µf, 500V, 1%, Sil Mica	811581049	79	DM15D102F
C6	33pf, 500V, Sil Mica	811581037	79	DM15D330J
C8	.01µf, 500V, 20%, Cer	811570019	48	5GAS-S10
C9	.01µf, 500V, 20%, Cer	811581019	48	5GAS-S10
C10	470pf, 500V, Sil Mica	811581014	79	DM15D471J
	DIODES			
CR1	IN823A, 6.2V	818175002		IN823A
CR2	IN823A, 6.2V	818175002		IN823A

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	MANUFACTURER CODE	MANUFACTURER PART NUMBER
A3	CAL OSCILLATOR CARD ASM (cont)	C31855G1		
	RESISTORS			
R1	113k, 1/8W, 1%, Metflm	817213113		RN60D
R2	113k, 1/8W, 1%, Metflm	817213113		RN60D
R3	110k, 1/8W, 1%, Metflm	817213110		RN60D
R4	110k, 1/8W, 1%, Metflm	817213110		RN60D
R5	511 ohm, 1/8W, 1%, Metflm	817210511		RN60D
R6	34.8k, 1/8W, 1%, Metflm	817212348		RN60D
R7	Pot, 50k	817806503	7	3299X-1-503
R8	1M, 1/4W, 5%, Fxd Comp	817007105		RC07
R9	1k, 1/4W, 5%, Fxd Comp	817007102		RC07
R10	3.9 ohm, 1/4W, 5%, Fxd Comp	817007399		RC07
R11	3.9 ohm, 1/4W, 5%, Fxd Comp	817007399		RC07
R12	1k, 1/4W, 5%, Fxd Comp	817007102		RC07
R13	10.0k, 1/8W, 0.1%, Metflm	817261048	42	PME55
R14	100 ohm, 1/8W, 0.1%, Metflm	817261032	42	PME55
S2	Switch, Rotary 3P 3 Pos, N-S	A88390P1	31	A88390P1
S2	Switch, Toggle, 3P3T	815128002	43	RCL-13-RCB-3
F1	Fuse, 1 1/2A Fast Acting	815183013	9	AGC
J1	Connector, BNC	812130110	19	30355-1
P1	Connector, 16 Pin	812122003	4	26-4100-16P
Q1	Transistor, Power	818700017		MJE1092
	RESISTORS			
R1	0.8 ohm, 7.5W, 5%, WW	817002014	43	RCL-AL5
R2	0.8 ohm, 7.5W, 5%, WW	817002014	43	RCL-AL5
R3	27k, 1/4W, 5%, Fxd Comp	817007273		RC07
S1-DS1	Switch, Neon-Lighted	815160007	34	616-6-1-A1H
T1	Transformer	B88100P1	31	B88100P1
XA2	Connector, 10 Pin	812127004	94	C-404-010

CODE LIST OF MANUFACTURERS

1	Aerovox
2	Alco Electronic Prod
3	Allen Bradley
4	Amphenol Connector
5	Analog Devices
6	Belden
7	Bourns
8	Buckeye Stamping
9	Bussman Mfg
10	Cambion
11	Cannon, ITT
12	Centralab
13	Cinch Mfg
14	C & K Components
15	Continental– Wirt Elec
16	Corcom
17	Cornell Dubilier Elec
18	CTS
19	Dage Electric
20	Delevan Electronics
21	Dresser Systems
22	Electrocube
23	Electro Motive Mfg
24	Electronics Applications
25	Erie Technological Products
26	Fairchield Semiconductor
27	Federal Screw Prod
28	General Electric
29	Helipot
30	Heyman Mfg
31	ITHACO
32	E F Johnson
33	Litronix
34	Marco–Oak Industries
35	Motorola Semiconductor Prod
36	National Semiconductor
37	Ohmite Mfg
38	Paktron
39	Panduit
40	Pomona Electronics
41	Product Components
42	Pyrofilm
43	RCL Electronics
44	Rembrandt
45	Rogan
46	Schauer Mfg
47	H H Smith
48	Sprague Electric
49	Spectrol Electronics
50	Stancor
51	D M Steward Mfg
52	Switchcraft
53	Teledyne Semiconductor
54	Teledyne Western Wire and Cable
55	Texas Instruments
56	Thermalloy
57	TRW
58	United Transformer
59	Useco
60	Vactec
61	Winchester Electronic
62	Vishay
63	ACI
64	IRC
65	EAL
66	AMP
67	Clarostat Mfg
68	Gould Inc
69	Littlefuse Inc
70	General Illumination
71	Signetrics
72	Semiconductor Cir
73	Statek
74	Bendix
75	Burndy
76	American Handle Sales
77	Varo Semiconductor
78	Dialco
79	Elmenco
80	Amp Incorporated
81	Berg
82	Comp Corp
83	Hewlett–Packard
84	Beckman Helipot
85	Raytheon
86	Intersil
87	A H & H
88	ADC Products
89	Scanbe
90	Drake
91	Victoreen
92	Frost
93	Sigma
94	Becon
95	Microswitch

TABLE 7.3 CODE LIST OF MANUFACTURERS

WARRANTY

ITHACO, Inc. warrants each instrument to be free of defects in material and workmanship for a period of one year, unless otherwise specified, after shipment to the original purchaser; batteries are specifically excluded. Liability under this warranty is limited to repairing or adjusting any instrument returned to the factory for that purpose. The warranty of this instrument is void if the instrument has been modified other than in accordance with written instructions from ITHACO, or if defect or failure is judged by ITHACO to be caused by abnormal conditions of operation, storage or transportation.

This warranty is subject to verification by ITHACO, that a defect or failure exists, and to compliance by the original purchaser with the following instructions:

1. Before returning the instrument, notify ITHACO with full details of the problem; include model number and serial number of the instrument involved.

2. After receiving the above information, ITHACO will give you shipping instructions or service instructions. After receipt of shipping instructions, ship the instrument to ITHACO. Full liability for damage during shipment is borne by the purchaser. It is recommended that instruments shipped to us be fully insured and packed surrounded by at least 2 inches of shock-absorbing material.

ITHACO reserves the right to make changes in design at any time without incurring any obligation to install same on units previously purchased.

This warranty is expressly in lieu of all other obligations or liabilities on the part of ITHACO, and ITHACO neither assumes, nor authorizes any other person to assume for it, any liability in connection with the sales of ITHACO instruments.

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